SNMTS Executive Board

Friday, June 13, 2008
10:00am – 2:00pm
Jefferson Ballroom
(Hilton)
Annual Meeting 2008
SNMTS Executive Board Meeting
Jefferson Ballroom (Hilton)
New Orleans, LA

AGENDA

Commencement: 10:00am

I. Welcome and Call to Order, David Gilmore, MS, CNMT, NCT, RT(R)(N), President
   A. Quorum Call, Peggy Squires, BS, CNMT, NCT, Secretary
   B. Commencement Actions
      1. ACTION: Approval of Agenda, David Gilmore, MS, CNMT, NCT, RT(R)(N)
      2. ACTION: Approval of Standing Rules, David Gilmore, MS, CNMT, NCT, RT(R)(N)
      3. ACTION: Approval of February 2008 Executive Board Minutes, Peggy Squires, BS, CNMT, NCT

II. Agenda Topics
   A. Review of Confidentiality Statement, David Gilmore, MS, CNMT, NCT, RT(R)(N)
   B. Finance Committee Report, David J. Perry, CNMT, PET, FSNMTS
   C. Management Fee Task Force, David J. Perry, CNMT, PET, FSNMTS
   D. International Travel, Mark Wallenmeyer, MBA, CNMT, RT(N)
      1. ACTION: Approve SNMTS President and President-Elect International Travel
   E. Advocacy Committee, Cindi Luckett-Gilbert, MHA, CNMT
   F. Advanced Practice Task Force, Martha W. Picket, CNMT, FSNMTS
      1. ACTION: Approve Professional Curriculum and Competencies for Nuclear Medicine Advanced Associates
   G. Educator’s Task Force, Cybil J. Nielsen, MBA, CNMT
      1. ACTION: Approve Professional Curriculum for Entry-Level Technologists
   H. SNMTS Mentoring Program, Ellie Zimmer, CNMT, NCT, RT(N)
      1. Review of Mentor List
I. Leadership Academy, Martha Hess-Smith, BS, CNMT
J. Nominating Committee Report, D. Scott Holbrook, BS, CNMT, PET, FSNMTS
K. PDEF Update, Elpida Crawford, CNMT

III. Written Reports from the Leadership
A. Report from the President, David Gilmore, MS, CNMT, NCT, RT(R)(N), President
B. Report from the President-Elect, Mark Wallenmeyer, MBA, CNMT, RT(N)
C. Report from the Immediate Past President, D. Scott Holbrook, BS, CNMT, PET, FSNMTS
D. Report from the SNM President, Alexander J. B. McEwan, MD
E. Report from the SNM President-Elect, Robert W. Atcher, PhD
F. Report from the SNM Vice-President Elect, Michael Graham, MD

IV. Staff Reports
A. Report from the Chief Executive Officer, Virginia Pappas, CAE
   B. Report from the Associate Director, Leadership Services, Nikki Wenzel

IV. Informational Reports
A. Advocacy Committee
B. Advanced Practice Task Force
C. Bylaws Committee
D. Education Committee
E. Educators’ Task Force
F. Membership Committee
G. Nominating Committee
H. Program Committee
I. Publications Committee

V. Unfinished Business

VI. New Business

VII. Adjournment
Welcome and Call to Order
Approval of Agenda
RESOLUTION FORM
SNMTS Executive Board
June 13, 2008

ACTION ITEM: Approval of Meeting Agenda

SUBMITTED BY: David Gilmore, MS, CNMT, NCT, RT(R)(N)
SNMTS President

PROPOSED RESOLUTION: Resolved, that the meeting agenda for the June 13, 2008,
SNMTS Executive Board Meeting be adopted.

FINANCIAL IMPACT: N/A

BACKGROUND: Robert's Rules of Order (current issue) provide that it is
customary to adopt an agenda for each session in organizations
that meet less than quarterly. An Agenda requires a two-thirds
vote (or unanimous consent) in order to be changed.

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Approval of Standing Rules
RESOLUTION FORM
SNMTS Executive Board
June 13, 2008

ACTION ITEM: Approval of SNMTS Executive Board Standing Rules

SUBMITTED BY: David Gilmore, MS, CNMT, NCT, RT(R)(N)
SNMTS President

PROPOSED RESOLUTION: Resolved, that the standing rules of the SNMTS Executive Board be adopted for this meeting.

FINANCIAL IMPACT: N/A

BACKGROUND: 30 minutes maximum of discussion of an item unless the National Council votes to extend; acceptance of Robert’s Rules of Order; no one speaks twice until all who wish have spoken once

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Approval of April 2008 Minutes
RESOLUTION FORM
SNMTS Executive Board
June 13, 2008

ACTION ITEM: Approval of April 25, 2008 SNMTS Executive Board Meeting Minutes

SUBMITTED BY: Peggy Squires, BS, CNMT, NCT
SNMTS Secretary

PROPOSED RESOLUTION: Resolved, that the minutes from the April 25, 2008 Executive Board Meeting minutes be adopted.

FINANCIAL IMPACT: N/A

BACKGROUND: N/A

SUPPORTING DOCUMENTS: April 25, 2008, SNMTS Executive Board Meeting Minutes

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April 25, 2008
SNMTS Executive Board
2008 Spring Meeting

Members in Attendance:
David Gilmore, CNMT, NCT, RT(R)(N); Mark Wallenmeyer, MBA, CNMT, RT(N); Kathy Thomas, MHA, CNMT, PET, FSNMTS; Elpida Crawford, CNMT; Peggy Squires, BS, CNMT, NCT; Frances Keech, MBA, RT(N), FSNMTS; Dave Perry, CNMT, PET, FSNMTS; Marcia Hess-Smith, BS, CNMT; Author J. Hall, CNMT, FSNMTS

SNM Staff in Attendance:
Virginia Pappas, CAE; Mike Nelson, CAE; Nikki Wenzel, Jenny Mills, Stephanie Cross, Joanna Spahr, Judy Brazel, Rebecca Maxey, Lynn Barnes, Teri Pinkham, Marybeth Howlett, Cecilia Noblett, Hugh Cannon, Vince Pistilli

I. Welcome and Call to Order
The SNMTS Executive Board meeting was called to order at 1:10pm by David Gilmore, SNMTS President. Peggy Squires, Secretary established that a quorum was present.

II. Commencement Actions

A motion was made to approve the SNMTS Executive Board Agenda.

It was moved, seconded, and voted to approve the SNMTS Executive Board agenda for April 25, 2008.

A motion was made to approve the SNMTS Executive Board minutes from the February 16, 2008 meeting as amended.

It was moved, seconded, and voted to approve the SNMTS Executive Board minutes from the February 16, 2008 meeting as amended.

A motion was made to approve the SNMTS Executive Board minutes from the February 16, 2008 meeting (executive session).

It was moved, seconded, and voted to approve the SNMTS Executive Board minutes from the February 16, 2008 meeting (executive session).

A motion was made to approve the SNMTS Executive Board standing rules for the April 25, 2008 meeting.

It was moved, seconded, and voted to approve the SNMTS Executive Board standing rules for the April 25, 2008 meeting.

III. Agenda Topics

A. Review of Confidentiality Statement
David Gilmore, SNMTS President, reviewed the confidentiality statement. Stating that, it is understood that leaders and volunteers of the SNMTS will not disclose, divulge, duplicate, publish, or make accessible confidential information to any persons other than those who have a legitimate need to know and whom the SNMTS has authorized disclosure.

B. Conflict of Interest Discussion
The National Council of Representatives, passed a resolution during the Mid-Winter NCOR Meeting, requesting that the Executive Board rescind their motion regarding staff members of liaison organizations. The NCOR resolution read as follows:

It was moved, seconded and voted to request that the Executive Board rescind the decision to consider a staff person of an SNMTS liaison organization, holding the office of Secretary or Finance Committee Chair to be considered in conflict. The NCOR does not support the decision to consider a staff person of an SNMTS liaison organization, holding the office of Secretary or Finance Committee Chair to be considered in conflict.

The SNMTS Executive Board went into Executive Session at 1:06pm.

The SNMTS Executive Board ended the Executive Session at 2:12pm.

C. Finance Committee

David J. Perry, Chair of the Finance Committee, gave a brief overview of the financials, expenses vs. positive bottom line. The current bottom line is $244,000, roughly $100,000 less than what we budgeted bottom line this time of year. Although the revenue is less than budget, the SNMTS is consistent from last year. Membership is up by 8% from last year, although an 11% increase was budgeted.

The SNMTS Finance Committee met via conference call and is recommending a $2.00 increase in regular technologist dues, bringing the new SNMTS member dues to $99.00. The Executive Board discussed the need for more member benefits if the dues are going to be increased.

A motion was made to increase regular technologist dues by $2.00 from $97.00 in FY2008 to $99.00 in FY2009.

It was moved, seconded and voted to increase regular technologist dues by $2.00 from $97.00 in FY2008 to $99.00 in FY2009.

The SNM/SNMTS Management Fee Task Force will meet on May 10 to review the proposed contract. A report will be given at the Executive Board meeting in June.

D. Committee Appointments

Mark Wallenmeyer, SNMTS President-Elect, reported on the status of the committee appointments. The appointments have been finalized. Letters will be sent to all the Committee Chairs first in order to give them the opportunity to review the committee charges and membership roster and make recommendations. Once the Committee chairs have agreed, the member appointment letters will be sent. This year, each committee charge includes its relationship to the strategic plan. Additionally, this year there will be an SNMTS Membership Committee focused on Chapter issues and an SNM/SNMTS Joint Membership Committee that will focus on marketing SNM/SNMTS membership.

The PDEF Executive Committee Slate was proposed as follows:

**Chair**: Scott Hollbrook, BS, CNMT, NCT, FSNMTS
Nancy Swantson, CNMT, RT(N), PET
Thomas Burnett, MD
Robert Carretta, MD
Elpida Crawford, CNMT
Kathy Thomas, MHA, CNMT, PET, FSNMTS
Edward Lyons, CNMT, RT(R)
Peggy Squires, BS, CNMT, NCT
It was moved, seconded and voted to approve the PDEF Executive Board slate as referenced above.

E. Mentoring Program
Mark Wallenmeyer, SNMTS President-Elect, outlined the SNMTS Mentoring Program that Ellie Zimmer created to bring SNMTS members into leadership positions within the society. The program will continue to be developed over the next several months.

F. Leadership Academy
Marcia Hess-Smith, Chair of the Leadership Academy Task Force informed the board of the current struggle to find funding. The SNMTS Leadership discussed this challenge on a conference call and decided to move forward with sending the application out and continue to work to secure funding.

G. Nominating Committee
The National election ballots were sent on April 7. The election closes May 15 at midnight. If you know of anyone that did not receive the ballot, please have them contact Nikki Wenzel. SNM Staff will send several reminder notices out regarding the ballot prior to the deadline. The National Council ballot will be sent the week of May 5.

H. Annual Meeting
David Gilmore, SNMTS President reported that the NCOR will continue to meet prior to the Executive Board during the governance meetings. In addition the House of Delegates meeting will now be on Friday night, prior to the 2nd SNM BOD Meeting.

I. Strategic Plan
David Gilmore reviewed the strategic plan summary that was included in the agenda. The SNMTS has had several significant accomplishments over the past year. David thanked the Committee Chairs for their hard work. This year, 2008-2009 will be the beginning of year 3 of the plan. Mark Wallenmeyer, SNMTS President-Elect is planning to create a task force to review the strategic plan in depth. The format used to for the summary will be the format that is used moving forward.

IV. Unfinished Business
A. Membership Committee Report
Mark Wallenmeyer, SNMTS President-Elect informed the Executive Board that an additional candidate had submitted an application for SNMTS Fellow. The candidate was very close, only missing the requirements for one section to be eligible. The candidate will serve on several committees next year in order to fulfill the requirements and then re-apply for next year.

B. Marketing CT Programs
Kathy Thomas, SNM Continuing Education Committee Chair, requested that more the CT programs be marketed more and moved to a more predominant section of the website, where it is easy to find. All the marketing materials are currently in production for the CT courses. Kathy requested that the timelines be sent to the Chairs of the committees in order to make sure that they get the information in on time to meet marketing deadlines.

V. New Business
A. Speaker-Elect Position
David Gilmore, SNMTS President, reported that Cindi Luckett-Gilbert had to step down as SNMTS NCOR Speaker-Elect for personal reasons. David requested the appointment of Frances Keech as SNMTS NCOR Speaker-Elect.
A motion was made to approve Frances Keech as the NCOR Speaker-Elect for a one-year term.

It was moved, seconded and voted to approve Frances Keech as the NCOR Speaker-Elect for a one-year term.

B. Department Updates
The SNM Department Directors gave an overview of the activities within their Department.

C. Paul Cole Write-Up
Kathy Thomas suggesting including a write-up about Paul Cole in the next JNMT. Frances Keech agreed to do the article.

VI. Adjournment
A motion was made to adjourn the SNMTS Executive Board Meeting at 3:44pm.

It was moved, seconded and voted to adjourn the SNMTS Executive Board meeting at 3:44pm.
Agenda Topics
Review of Confidentiality Statement
CONFIDENTIALITY POLICY

As leaders and volunteers of the SNMTS we are often asked to deal with sensitive information about volunteers, staff, other organizations, and industry. We are often privy to confidential information critical to the well being on the organization. Confidentiality is important to our organization’s credibility and reputation. Therefore, it is in our best interest to adopt a confidentiality policy.

It is understood that leaders and volunteers of the SNMTS will not disclose, divulge, duplicate, publish, or make accessible confidential information to any persons other than those who have a legitimate need to know and whom the SNMTS has authorized disclosure.

Leaders and volunteers are expected to hold in confidence materials, manuals, or policies that represent works in progress or drafts. The expectation is that when decisions or documents are finalized they will be publicly disclosed or published.

Leaders and volunteers must exercise good judgment and care at all times to avoid unauthorized or improper disclosure of confidential information. Conversations in public should be limited to matters that do not pertain to information of a sensitive or confidential nature.

When decisions are made, even if not unanimous, the expectation is that when discussing relevant details with outside organizations the guiding principal shall be that the information shared/imparted/conveyed will be with the best interest of the organization in mind.

These policies are not intended to prevent disclosure where disclosure is required by law. Rather, these policies are intended as a template for ethically handling information of a confidential or sensitive nature.
Finance Committee Report

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<td>$ 157,467</td>
<td>$ 151,568</td>
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<td>$ 1,983,154</td>
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<td>$ (55,320)</td>
<td>$ 190,309</td>
<td>$ 266,206</td>
<td>(75,898)</td>
<td>$ 11,416</td>
<td>$ (845)</td>
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Management Fee Task Force
International Travel
RESOLUTION FORM  
SNMTS Executive Board  
June 13, 2008

**ACTION ITEM:** SNMTS President and President-Elect International Travel

**SUBMITTED BY:** Mark Wallenmyer, MBA, CNMT, RT(N)

**PROPOSED RESOLUTION:** If the SNMTS President or President-Elect is traveling internationally, they may elect to travel in coach and use the difference in premium to pay for family member travel. The total cost of the individual plus family SHOULD NOT exceed the lowest business class fare.

**FINANCIAL IMPACT:** N/A

**BACKGROUND:** The current travel policy for the SNM Board of Directors states that a Board Member traveling internationally may fly business class. As members of the SNM Board of Directors, the SNMTS President and President Elect fall under this policy. Documentation of lowest business fare must be provided in writing from SNM Travel Agency.

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Advocacy Committee
Committee Charges for 2007-2008:

1. Educate SHPLs, members, and the public of issues important to the nuclear medicine molecular imaging professions by offering lectures, newsletters, and articles

2. Grow the SHPL program to enhance grassroots efforts

3. Communicate with law makers to promote the SNMTS position on issues important to our profession

4. Collaborate with other like-minded organizations in the effort to advance our advocacy initiatives

5. Prepare resources for the membership and public regarding advocacy issues

Current Working Objectives/Goals:

1. Find a representative from each state as a resource when questions come into the SNM regarding state specific issues

2. Send monthly e-newsletters including SHPLs, HPRA, Chapters

3. Represent the SNMTS Advocacy at each Chapter’s meetings for lectures and education in conjunction with HPRA

4. Communicate with Chapters and NCDs on a regular basis to maintain knowledge flow of current events and issues brought before the Advocacy Committee

5. Communicate with SHPLs via newsletters and issue updates at least monthly to keep them current and motivated

6. Attend Alliance Meetings & CRCPD Meetings as representatives of the SNMTS Advocacy Committee

Progress of Charge/Objectives/Goals to Date:

- CARE Bill update: At this writing, the enforcement section of the S.1042 paragraph h is still not added back to the bill. The House of Representatives has not yet pulled section h out of HR 583 but it is expected to do so. The CARE bill has reached 10 years of effort trying to pass these minimum education standards.

- In cooperation with Alliance for Quality Imaging and Radiation Therapy (AQMIRT) the SNMTS Also the Alliance is working through its differences in accreditation opinions which has been tabled until the CARE bill passes.
• The final revision of the USP-797 was released in December 2007 which will make a major impact on the way nuclear medicine hot laboratories operate. Little information has come from the SNM to assist the SNMTS with helping to distribute implementation material or to help determine what impact this has on rural nuclear medicine hot laboratories.

• The University Health Consortium has drafted a white paper called The Medication Reconciliation Project to define and provide its opinion of medication reconciliation to The Joint Commission. The Advocacy chair participated in this draft representing the SNMTS.

• March 9-11, 2008 the ASRT’s RT in DC was held. 11 of NMTs participated. It was during this time attendees learned about the removal of paragraph h in S.1042.

• The CRCPD Board of Directors asked the SNMTS Advocacy Chair to present a twenty minute presentation at its Annual Meeting at the May 2008 meeting in Orlando, Florida to discuss the CARE bill as well as participate in the State Suggest Regulations Z-Medical Credentialing Committee. One of the Advocacy Committee goals is to expand the relationship with the CRCPD by including at least one representative from the SNM in order to assist the CRCPD with its goals as well as use their resources for the SNM and SNMTS’ needs.

• The SNMTS sent a letter to Mayor Bloomberg of New York City opposing its desire to enact a regulation prohibiting unauthorized persons to operate radiation detectors.

• The committee will have a CE session at the Annual Meeting Tuesday, June 17th from 9:45 am to 2:00 pm with lectures such as Medication Management, USP-797 implementation, The Joint Commission National Patient Safety Goals, and the CARE Bill.

• Locating state regulatory representatives from each state and have 20% completed.

• Revitalizing SHPLs by renaming them the Key Advocates and asking them to take on greater responsibilities such as completing monthly assignments and reporting back to Government Relations. Progress has been slow due to low response from former SHPLs.

**Additional Goals/Objectives Added for 2007-2008:**

- Drafting a 3 year strategic plan for the committee – in process
Advanced Practice Task Force
EXPANDED COMPETENCIES FOR THE
NUCLEAR MEDICINE ADVANCED ASSOCIATE (NMAA)

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 the clinical skills expected of other lateral middle-level providers, primarily Physician Assistants (PA), Radiologist Assistants (RA), and Nurse Practitioners (NP). 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, course work 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 US and Europe. They are similar to education models promoted by the Accreditation Council of Graduate Medical Education (ACGME)’s “Outcomes Project” (6). This project resulted in the establishment of baseline standards and competencies for medical residents to meet the needs of the modern healthcare 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 upon 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, 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 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 where 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.

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 Communication 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 such activities as quality improvement programs, patient safety programs, or grand round conferences. Professionalism encompasses the adherence to ethical principles such as the provision of care, confidentiality, informed consent, 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 to those assuming administrative tasks.
PATIENT CARE

1. Communicate effectively and demonstrate caring, respectful and ethical behaviors when interacting with patients, their families, physicians and other health care professionals.
   (see Interpersonal and Communication Skills competency domain)

2. Counsel and educate patients and their families.
   a. Obtain patient informed consent for required procedures according to state law and institutional policy.
   b. Educate patients on pre-procedural preparation and post-procedural care.

3. 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 patients and arrange follow-up as necessary under the direction of the supervising physician.
   b. Perform history and physical examinations
   c. Evaluate findings for contraindications to testing and for indicators of additional patient pathology.
   d. Consult with physician as needed.
   e. Counsel patient and family as indicated.

4. 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 patients per protocol.

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

6. 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 IV injection or oral
   c. Monitor vital signs and physiological parameters.
   d. Evaluate the need for contrast media in consultation with the supervising physician.

7. 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

1. 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 for indications/contraindications.
   d. Order or facilitate adjunctive pharmaceuticals for the imaging procedure under the direction of the supervising physician.

2. 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 patients and ancillary equipment for radiation therapy planning using positron and multimodality imaging systems

3.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 pre-procedure requirements and interventions as may be required.
   b. Perform intra-procedure requirements as may be required.
   c. Perform post-procedure requirements as may be required.

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

5. Analyze results of the procedure and prepare a comprehensive report for the supervising physician.
   a. Assess image quality and other associated data.
   b. Make a preliminary interpretation.
   c. Document initial observations of imaging procedures according to protocol.
   d. Communicate initial observations as per supervising physician discretion.
   e. Report findings to referring physicians and patients per protocol.

Therapy Core Competencies

1. Review request for radionuclide therapy procedures under the direction of the supervising physician, analyzing the indications, contraindications, complications for therapeutic interventions.
   a. Interpret epidemiological data, research and trends related to incidence and prevalence of cancer.
   b. Identify risk factors for cancer.
   c. Conduct imaging protocols and evaluate images and laboratory values for presence of disease and metastasis.
d. Evaluate clinical criteria for radionuclide therapy, including expected biodistribution of radiotherapeutic pharmaceutical.

2. Counsel and educate the patients and their families regarding the proposed therapeutic intervention.
   a. Obtain translator/interpreter services as necessary.
   b. Obtain patient informed consent for required procedures according to state law and institutional policy.
   c. Educate patients on pre-procedural and post-procedural care.

3. Calculate and administer appropriate therapeutic dosage based upon 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 (SIRT), basing dose selection on accepted standards.

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

5. Ensure appropriate laboratory work has been completed prior to treatment.

6. Report procedure to supervising physician according to protocol.

7. In conjunction with referring and supervising physician, monitor patient and provide post therapy intervention as needed for adverse side effects.

Elective Competencies

1. Administer radiopharmaceuticals for radionuclide cisternography, cerebrospinal fluid shunt evaluations, cerebrospinal fluid leaks or for intraperitoneal procedures using aseptic technique and radiation safety standards at the discretion of the supervising physician
   a. Explain complete procedure to 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.
2. 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 biopsied tissue for pathological 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.
   j. Advise patient of needed follow-up care.

3. Manage pain and sedation for patients 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

1. Successfully complete Advanced Cardiac Life Support credentialing.
   a. Assess normal ECG to determine patient safety for stress testing.
   b. Assess abnormal ECG conduction in preparation for stress testing.

2. 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 patients who develop asymptomatic bradycardia or tachycardia while in office (before, during or after stress test).
   c. Follow a step-by-step course of action for patients who develop 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 (STEMI).
   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.
3. 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 IV 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 labs or other tests as needed for a cardiac arrest event under the direction of the supervising physician.
   e. Facilitate admission of patient to hospital if necessary.

4. Provide indicated intervention for non-cardiac emergency events.

5. 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.

6. Take comprehensive patient history and evaluate for patient pathology.
   a. Interview patient and document on department form a complete past and current cardiac history.
   b. Establish NPO compliance.
   c. Evaluate ambulatory ability.
   d. Review non-cardiac history for prevalence to study requested.
   e. Perform physical assessment.

7. 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).

8. 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.

9. 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 capability of patient to give informed consent.
   c. Explain procedure to the patient, including all components of a valid informed consent.
   d. Obtain the patient’s or guardian’s signature.

10. Conduct treadmill testing per all protocol options under the direction of the supervising physician.
    a. Prepare patient for exercise protocol.
    b. Determine type of exercise stress test.
c. Monitor ECG 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.

11. Prescribe and administer interventional drugs for pharmacological stress under the direction of the supervising physician.
   a. Explain the indications and contraindications for each pharmacologic stress agent.
   b. Identify the physiological 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 pharmacological 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 patients appropriately in the event of an adverse effect.

12. Analyze results of the stress test and imaging portion of the examination and prepare a comprehensive report for the supervising physician.
   a. Create a comprehensive report 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 vs. resting processed images for perfusion defects.
   e. Determine if the heart-to-lung ratio and TID 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 comprehensive report detailing the results of the imaging portion of the test.

13. 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 complimentary diagnostic procedures as indicated.
   b. Identify the clinical pathways as outlined by the AMA/ACC for cardiac disease.

INTERPERSONAL AND COMMUNICATION SKILLS

1. 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 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.
2. 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.

3. 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 patient, families, and colleagues.
   d. Demonstrate effective age-specific and gender-specific communications.
   e. Be receptive to the clinical significance of the patient’s personal beliefs and values for adaptation of an exam protocol or departmental policies.

4. 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.

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

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

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

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

9. Demonstrate technical writing ability in a variety of venue, 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.
10. Apply concepts of teaching and learning theories in design, implementation and evaluation in the education of patient, family, colleagues and the community.

**PRACTICE-BASED DECISION MAKING**

1. Track and analyze processes, procedures and outcomes using appropriate statistical and/or qualitative techniques.
   a. Use the evidence-based medicine (EBM) 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.

2. 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.

3. 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 patients’ 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.

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

5. 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, protecting, or deleting sensitive information.

6. Provide discipline-specific education to 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

1. Demonstrate calm, compassionate, helpful demeanor toward those in need.

2. 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.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.
8. Demonstrate a commitment to medico-legal and ethical principles.
   a. Apply the ethical principles of autonomy, non-malfeasance, 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

1. 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.

2. Practice cost effective healthcare 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, 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 CMS policies and procedures, state, and federal law.

3. Ensure compliance for 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.

4. 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 patients in dealing with system complexities.

5. 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 (e.g. demographics and socio-cultural 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.
6. Describe the major legal mechanisms for oversight and regulation of medical practice, including those related to licensure and discipline, negligence, malpractice, risk management, doctor-patient relationships, confidentiality, and patient’s 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 the patient’s directives in regard to medical care.
   f. Comply with employer and employee legal obligations.
Reference Section


Overview for the Patient Care Curriculum

The role of the NMAA is to provide a quality patient care experience at the 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 ACLS certification and demonstrate a comprehensive knowledge of anatomy, physiology, pathology and pathophysiology that would have been included in their undergraduate nuclear medicine technology program. In addition to instruction in advanced patient care skills, NMAA students could also be expected to take graduate level instruction in pathophysiology and clinical pharmacology.
8. Communicate effectively and demonstrate caring, respectful and ethical behaviors when interacting with patients, their families, physicians and other health care professionals. [see Interpersonal and Communication Skills competency domain]

9. Counsel and educate patients and their families.

   a. Obtain patient informed consent for required procedures according to state law and institutional policy.
      i. 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. Force of circumstances
         f. Change of circumstances
      ii. Capability of patient to give informed consent.
      iii. Explanation of procedure to the patient, including all components of a valid informed consent.
         1. Risks
         2. Benefits
         3. Alternatives
         4. Precautions used to reduce risks
      iv. Assess patient's understanding of the risks, benefits and alternatives
and follow-up
v. Responding to questions or directing questions to the appropriate health care professional

b. Educate patients on pre-procedural preparation and post-procedural care.
   i. Dietary requirements
   ii. Modification of medication
       1. Restrictions
       2. Resumptions
   iii. Follow-up appointments
   iv. Next step in patient treatment algorithms
   v. Physical activity limitations

10. 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 patients and arrange follow-up as necessary under the direction of the supervising physician.
   i. Pertinent patient laboratory biochemical markers relevant to pathology
       1. Chemistry
       2. Hematology
       3. Microbiology
       4. Histology/cytology
   ii. Pertinent previous diagnostic imaging studies
       1. x-ray
       2. Ultrasound
       3. CT
       4. Nuclear procedures
       5. MRI
       6. Angiography
       7. Mammography

b. Perform history and physical examinations. (See Appendix for History and Physicals for RA curriculum)
   i. Review of systems (See Appendix Review of Systems for RA curriculum)
   ii. History of present illness
       1. Onset
       2. Provocation
       3. Quality
       4. Radiation
       5. Severity
       6. Time
       7. Previous Diagnosis
       8. Previous treatment
   iii. Past medical history
       1. Medications
       2. Allergies
       3. Surgeries
4. Medical conditions
   iv. Family history

v. Perform a focused physical exam
   1. Neurological
   2. General
   3. Psychosocial
   4. Cardiovascular
   5. Pulmonary
   6. Gastrointestinal
   7. Musculoskeletal
   8. Reproductive
   9. Genitourinary
  10. Pain
  11. Vital signs

c. Evaluate findings for contraindications to testing and for indicators of additional patient pathology.

d. Consult with physician as needed.

e. Counsel patient and family as indicated.

11. 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 patients per protocol.

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

   i. Indications
   ii. Contraindications
   iii. Co-morbidities
   iv. Legal issues

13. 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 IV injection or oral
i. Feeding tube
   1. Insertion
      a. NG
      b. OG
   2. Administration
      a. NG
      b. OG
      c. PEG
      d. Gastrostomy

ii. Rectal
   1. Insertion
   2. Administration
      a. Radiopharmaceuticals
      b. Pharmaceuticals
      c. Contrast media
   iii. Administration into existing catheters or surgical routes
      1. Peritoneal catheters
      2. VP shunts
      3. Central lines
      4. Intra-arterial lines

c. Monitor vital signs and physiological parameters.
   i. Blood pressure
   ii. Pulse
   iii. Pulse oxygen level
   iv. Temperature
   v. O2 sats
   vi. Endo-tidal CO2
   vii. Capnography
   viii. EKC
   ix. Cardiac output
   x. Drainage catheters

d. Evaluate the need for contrast media in consultation with the supervising physician.
   i. Indications/contraindications
   ii. Manage adverse events

14. Provide indicated intervention per patient emergency event.
   a. Provide supportive medical management.
      a. Adverse response
      b. Allergic response
      
    b. Provide basic life support.

   c. Provide advanced life support.
      
   d. Facilitate transfer to definitive care environment.
Overview for the Clinical Nuclear Medicine Curriculum

Clinical leadership exemplifies one of the most important roles of the NMAA and is integrated throughout the advanced practice curriculum. Those that 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 discreet 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.

NMAA’s 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, NMAA’s 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 complimentary diagnostic procedures as allowable by state and federal statutes. The NMAA may also prepare a comprehensive report for the supervising physician. NMAA students should expect to spend extensive time in the clinical setting and the classroom in order to master these skills.
Clinical Nuclear Medicine Curriculum Content

Core Imaging

6. 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 for indications/contraindications.
      i. Cardiac
         1. CK
         2. CKMB
         3. Troponin
         4. Lipid panel
         5. Prior EKG
         6. Prior cardiac procedures (cath, bypass, etc.)
      ii. Hepatic
         1. LFTs
         2. Chemistry panel
      iii. Pulmonary
         1. D-dimer
         2. BNP
         3. PT
         4. PTT
         5. INR
      iv. Oncology
         1. Tumor markers (e.g., Ca-125, AFP, serum CEA, serum Thyroglobulin)
         2. Blood glucose
      v. Renal study
         1. Chemistry panel
         2. Urinalysis
      vi. Thyroid
         1. Free T3
         2. Free T4
         3. TSH
         4. Thyroglobulin
         5. Thyroglobulin antibodies
      vii. Parathyroid
         1. PTH
         2. Calcium
   d. Order or facilitate adjunctive pharmaceuticals for the imaging procedure under the direction of the supervising physician.
      1. Morphine
      2. SSKI
3. Tagament
4. Cardiac stress agents
5. GI agents
   a. Cimetidine
   b. Ranitidine
   c. Pentagastrin
   d. Glucagon
   e. CCK or analog

7. 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.
      i. Anatomy and physiology of lymphatic system
         1. Breast
            a. Contains greater concentration than any other part of the body
            b. Lymph node or gland
               i. Subclavian
               ii. Interpectoral
               iii. Axillary
               iv. Parasternal (internal mammary)
         2. Melanoma
            a. Head and neck levels
               i. Submandibular triangle (I)
               ii. Upper jugular (II)
               iii. Middle jugular (III)
               iv. Lower jugular (IV)
               v. Spinal accessory nerve lymph chain (V)
               vi. Paratracheal (VI)
            b. Head and neck lymph drainage patterns
               i. Lower lip: Submental
               ii. Scalp: parotid, suboccipital
               iii. Parotid : levels I, II
               iv. Oral cavity: levels I, II, III
               v. Oral pharynx: levels II, III, retro & parapharyngeal
               vi. Nasopharynx: levels II, III, V
               vii. Hypopharynx: levels II, III, IV, retro & parapharyngeal
               viii. Supraglottis: levels II, III
              ix. Glottis: levels III, IV, VI
              x. Thyroid: levels III, IV, V, VI
              xi. Esophagus:levels III, IV, V, VI
            c. Torso/trunk (2) above umbilicus
               i. Axilla
               ii. Groin
               iii. Supraclavicular
               iv. Costal margin
               v. Internal mammary
vi. Interval note

d. Pelvis (below umbilicus)
   i. Inguinal
   ii. Mesenteric
   iii. Intestinal
   iv. Mesocolic
   v. Iliac
   vi. Retrosacral

e. Extremities
   i. Arm (3)
      1. Axillary
         a. Apical
         b. Central
         c. Lateral
         d. Subscapular
         e. Para-trochlear (interval node sometimes present)
      2. Intercostal
      3. Subital
      4. Infraclavicular
      5. Pectoral
      6. Subscapular
      7. Supraclavicular
      8. Tranverse cervical
   ii. Leg (4)
      1. Inguinal
      2. Iliac
         a. External
         b. Common
         c. Internal
         d. Deep
         e. Superficial
      3. Para-aortic
      4. Lumbar
      5. Popliteal
      6. Superficial inguinal nodes

3. Solid organ (e.g., biopsy-proven colorectal cancer)

ii. Injection technique

1. Intradermal
   a. Local systemic route
   b. Melanoma
2. Peritumoral
   a. Melanoma
   b. Breast
3. Subcutaneous
4. Periareolar
   a. Breast
5. Perirectal
   a. Solid organ
iii. Radiopharmaceutical
   1. Agent: Tc99m sulfur colloid (filtered)
   2. Dose
   3. Route of administration (see injection technique)
   4. Volume limitation
   5. Particle size
   6. Needle size

iv. Pharmaceutical intervention: anesthetic

v. Patient positioning and immobilization devices
   1. Positioning
      a. Therapy planning table
      b. Positioning devices (e.g. wedges)
   2. Immobilization
      a. Casts/masks
      b. Vacuum bags

   c. Prepare patients and ancillary equipment for radiation therapy planning using positron and multimodality imaging systems.
      i. Equipment
         1. Masks
         2. Therapy planning table
         3. Positioning appliances
         4. Other ancillary equipment
      ii. Laser positioning and reference marking

8. 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 pre-procedure requirements and interventions as may be required.
      i. Dietary status
         1. NPO per department protocol
            a. Hepatobiliary
            b. Gastric empty
            c. Thyroid uptake/scan
            d. Gastric reflux
            e. C-14 urea breath test
         2. Pre-arranged meals
            a. Fatty
            b. Low iodine
            c. Low carbohydrate
            d. High protein
      ii. Hydration per department protocol
         1. Renal imaging
         2. PET
iii. Medication discontinued per department protocol
   1. Thyroid uptake/scan
   a. T-3
   b. T-4
   c. Propylthiouracil/Tapazol
   d. Iodinated contrast
   2. Adrenal medullary imaging
   a. Opioids
   b. Tricyclic antidepressants
   c. Sympoathicomimetics
   d. Antihypertensive/cardiovascular agents
   e. ACE inhibitors
   f. Antipsychotics
   3. C-14 Urea breath test
   a. Antibiotics
   b. Bismuth
   c. Sulfates
   4. Captopril renal scan
   - Diuretic
   - ACE inhibitor
   - Calcium antagonists
   - Angiotensin II receptor blockers

iv. Activity limitation as clinically indicated
   ✤ PET - reduce physical activity,
   ✤ PET - eliminate speech

v. Laboratory evaluations as per department protocol (see competency #1)

b. Perform intra-procedure requirements as may be required.
   i. Medications as per department protocol
      1. Morphine intervention for hepatobiliary imaging
         a. Dose
         b. Dose limits
         c. Administration technique
      2. CCK intervention for hepatobiliary imaging
         a. Dose
         b. Administration technique
      3. Lasix (furosemide) for renal imaging
         a. Dose
         b. Administration technique
   ii. Activity limitations as clinically indicated (See A above)
   iii. Dietary status as per department protocol (See A above)
   iv. Laboratory evaluation as per department protocol
   v. Vital signs: see Patient care Competency domain

c. Perform post-procedure requirements as may be required.
   i. Activity limitations as clinically indicated
   ii. Medications as directed by referring physician or supervising physician
      1. Administration of additional medications as directed by referring physician or supervising physician
      2. Ensure that patients do not take metformin containing medications
48 hours after administration of iodinated contrast material
3. Insure children are rehydrated post diuretic study
   iii. Dietary limitations
      1. NPO 1 hour post dose – thyroid uptake
      2. Hydration – facilitate urination
   iv. Laboratory evaluation – as clinically indicated

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

10. Analyze results of the procedure and prepare a comprehensive report for the supervising physician.
    a. Assess image quality and other associated data.
       i. Adequacy
       ii. Artifact
       iii. Incidental findings
    b. Make a preliminary interpretation.
       i. Incidental findings
       ii. Review correlative data
       iii. 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.
       i. Patient identification
       ii. Informed consent, as necessary
       iii. Referral prescription
       iv. Patient preparation
       v. Relevant clinical history
       vi. Radiopharmaceutical, dose and route of administration
       vii. Patient status prior to, during and following procedure/therapy
       viii. Statement outlining patient radiation safety instructions, as necessary
       ix. Recommendations for follow-up diagnostic or therapeutic procedures, as indicated
       x. Recommendations for follow-up, as needed
    d. Communicate initial observations as per supervising physician discretion.
    e. Report findings to referring physicians and patients per protocol.
       i. Recommend appropriate diagnostic or therapeutic procedures as indicated.
       ii. Recommend appropriate follow-up, as needed.

Therapy Core Competencies

1) Review request for radionuclide therapy procedures under the direction of the supervising physician, analyzing the indications, contraindications, complications for therapeutic interventions.
f. Interpret epidemiological data, research and trends related to incidence and prevalence of cancer.
   i. Malignant versus benign tumors
   ii. Proto-oncogenes
   iii. Statistical interpretation
   iv. Life style/environmental risks
   v. Clinical treatments
      1. curative/palliative
         a. Surgical
         b. Medical
         c. Medication
   vi. Clinical studies
   vii. Life expectancy

g. Identify risk factors for cancer.
   i. Previous cancer/treatment
   ii. Genetic risk
   iii. Environmental risk

h. Conduct imaging protocols and evaluate images and laboratory values for presence of disease and metastasis.
   i. Coordinate imaging protocols per protocol, reference patient care
   ii. Tumor markers
   iii. Evaluation for metastatic disease, reference patient care and core imaging
   iv. Order or facilitate necessary laboratory and imaging studies per protocol and physician directive

i. Evaluate clinical criteria for radionuclide therapy, including expected biodistribution of radiotherapeutic pharmaceutical.
   i. Bone marrow suppression and secondary to added chemotherapy within 6 week window
   ii. Unintended thyroid ablation
   iii. Pulmonary fibrosis secondary to pulmonary metastasis
   iv. Exclude patients with pain from other causes which is mimicking bone pain
   v. Evaluate impending spinal cord compression or impending long bone fractures
   vi. Evaluate renal function to lower dosage or delay therapy
   vii. Exclude pregnant patients
   viii. Exclude patients for 2-3 days receiving other phosphonate-based therapy

8. Counsel and educate the patients and their families regarding the proposed therapeutic intervention.
   a. Obtain translator/interpreter services as necessary.
b. Obtain patient informed consent for required procedures according to state law and institutional policy.
   i. Educate the patient on the risks, benefits and alternatives to the procedure.
      1. Thyroid disease
         a. Benign thyroid disease
            i. Risks
               1. More than one I-131 treatment may be necessary
               2. Risk of hypothyroidism is high resulting in lifelong daily ingestion of thyroid medication
               3. Long term follow-up necessary
               4. Ophthalmopathy may improve or worsen or develop after I-131 (Graves Disease)
               5. Radiation thyroiditis/thyroid storm (rare)
            ii. Benefits
               1. Reduction/cell death of overactive thyroid tissue
               2. Reduce/ eliminate dependent medications
               3. Reduce/ eliminate associated symptoms
               4. Prevents cardiac damage
            iii. Alternative to treatment:
               1. Surgery
               2. Pharmaceutical therapy
               3. No therapy
         b. Malignant thyroid disease
            i. Risks
               1. Normal as well as cancerous thyroid tissue will be destroyed. Other normal tissues may also be affected
               2. More than one I-131 treatment may be necessary
               3. Early side effects
                  a. Mucositis
                  b. Nausea/vomiting
                  c. Pain/tenderness in salivary glands
                  d. Loss of salivia or taste
                  e. Metallic-like alterations in taste
                  f. Neck pain/swelling (rare)
                  g. Temporary decreased white blood cell count (increased susceptibility to infection) (very rare)
4. Late side effects
   a. Temporary infertility
   b. Permanent damage to salivary glands
      i. Loss of saliva or salivaolethiasis
      ii. Excessive dental caries
      iii. Reduced taste
   c. Dry eyes
   d. Epiphora from scarring of lacrimal ducts
   e. Development of other malignancies (rare)
      i. Stomach
      ii. Bladder
      iii. Colon
      iv. Salivary glands
      v. Leukemia (dose related and most significant late sequelae)

5. Lifelong daily ingestion of thyroid medication will be required

6. Long term follow-up necessary

ii. Benefits
   1. Destruction of malignant and normal thyroid tissue

iii. Alternatives to treatment
   1. External beam therapy
   2. Surgery

2. Palliative bone therapy (P-32, Sm-153, Sr-89)²
   a. Risks
      i. Potential for pain flare at 7 to 10 days post RX
      ii. Reduction in leukocytes, platelet counts resulting in bleeding/infection and potentially, death
      iii. Chance of total pain relief rare
      iv. Not a curative treatment
   b. Benefits
      i. Bone pain reduction
      ii. Improved mobility/quality of life
      iii. Reduce dependence on narcotic and non-narcotic analgesics
      iv. Improve performance status and possibly survival
      v. Reduce co-treatment costs
   c. Alternatives to treatment
      i. External beam therapy
      ii. Chemotherapy

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a. Risks

i. Hematologic events
   1. Neutropenia
   2. Thrombocytopenia
   3. Anemia
   4. Ecchymosis

ii. Digestive symptoms
   1. Nausea
   2. Vomiting
   3. Diarrhea
   4. Anorexia
   5. Abdominal enlargement
   6. Constipation

iii. Musculoskeletal system
   1. Arthralgia
   2. Myalgia

iv. Nervous system
   1. Dizziness
   2. Insomnia

v. Respiratory system
   1. Dyspnea
   2. Increased cough
   3. Rhinitis
   4. Bronchospasm

vi. Skin/appendages
   1. Pruritus
   2. Rash

vii. Whole body
   1. Fever
   2. Infection
   3. Chills
   4. Abdominal pain
   5. Pain
   6. Headache
   7. Throat irritation
   8. Back pain
   9. Flushing

viii. Cardiovascular
   1. Hypotension

ix. Anaphylactic shock (acute)
   1. Death

x. Non response to treatment protocol

xi. HAMA

xii. Hypothyroidism (Bexxar)
   1. Lifelong daily ingestion of thyroid medication may be required

b. Benefits
15 May 2008

i. Target treatment to CD-20 antigen expressed on normal and abnormal B-cells resulting in cell destruction/death (possible partial or complete remission)

ii. Durable response to therapy - results comparable to chemotherapy and external beam therapy

iii. Short outpatient treatment protocol (14 days)

iv. Improved quality of life during/following treatment protocol

c. Alternative to treatment
   i. Chemotherapy
   ii. External beam therapy
   iii. Watch/wait – no therapy

4. Polycythemia
   a. Risks
      i. Hematologic event (transient reduction in platelets and leucocytes) resulting in possible bleeding/infection
   b. Benefits
      i. Reduction in total RBC volume
      ii. Repeat treatments possible
      iii. Reduction in platelet counts to prevent clotting
   c. Alternative to Treatment:
      i. Chemotherapy
      ii. Pharmacological therapy

5. Malignant effusion
   a. Risks
      i. Hematologic events (transient reduction in platelet and leukocyte counts; rare)
      ii. Sub-optimal treatment outcome due to loculation in thoracic or peritoneal cavity
      iii. Tissue necrosis
      iv. Not a curative treatment
   b. Benefit
      i. Reduction of malignant cells in the thoracic or peritoneal cavity
      ii. Delayed fluid build-up in thoracic or peritoneal cavity
      iii. Repeat procedures possible
   c. Alternatives to treatment
      i. Chemotherapy (treatment of choice)

6. Selective Internal Radiation Therapy (SIRT)
   a. Risks
      i. Chronic pain
      ii. Ulceration/bleeding
      iii. Lung edema/fibrosis when lung shunting exceeds 20%
iv. Local radiotherapeutic treatment may include destruction of normal liver tissue
v. Not a curative treatment

b. Benefits
i. Local radiotherapeutic treatment to embolized liver tumors produces cell death to malignant tumor
ii. Procedure may be repeated
iii. Short treatment protocol performed over 7-14 days (diagnostic + therapeutic)

7. Radiosynoviorthesis (RSV)
a. Risks
i. Pain
ii. Joint inflammation
iii. Infection
iv. Not curative procedure

b. Benefit
i. Reduction in painful joint swelling including post-op prosthesis
ii. Procedure may be repeated

c. Alternative to treatment
i. Pharmacological therapy
ii. Surgery

ii. Assess patient’s understanding of risks, benefits and alternatives and follow-up
1. Address and document patient’s questions and concerns
   a. Consider cultural diversity and ethical issues
   b. When approved by patient, include family members/friends to improve communication/understanding

   c. Identify the need for an interpreter, as necessary
   i. Language
   ii. Hearing impaired

d. Document as per institutional protocol
   i. Discussion topics
      1. Risks
      2. Benefits
      3. Alternatives to treatment
   ii. Patient’s questions, issues or concerns
   iii. Barriers to communication
      1. Emotional
2. Psychological
3. Physical (Motor deficit)
4. Cultural/Spiritual
5. Age Specific
   a. Neonate
   b. Pediatric
   c. Adolescent
   d. Geriatric
iv. Final discussion outcome
   1. Consent to treat
   2. Refusal of treatment

c. Educate patients on pre-procedural and post procedural care.
   i. Dietary requirements
      1. Low iodine diet 10-14 days pre-treatment – I-131 rx – thyroid cancer
      2. NPO
         a. I-131 treatment (benign and malignant treatment protocols)
         b. Selective Internal Radiation Therapy (SIRT)
   ii. Modification of medications
      1. Restrictions
         a. Thyroid
            i. Thyroid hormones (unless rhTSH is used)
            ii. Iodinated contrast
            iii. Medications that may limit/restrict the ability of thyroid tissue to absorb radioactive iodine
         b. Bone palliation
            i. Oral/systemic myelosuppressive chemo
            ii. Bisphosphonates
      2. Resumptions – per procedural protocol and referring physician/radiologists directives
   iii. Follow-up appointments – per procedural protocol and referring physician/radiologists directives to include:
      1. Diagnostic imaging
      2. Laboratory follow-up
      3. Referring physician follow-up
      4. Treating physician follow-up
   iv. Next step in patient treatment algorithms – in consultation with treating physician, per referring physician’s directives
   v. Counsel patient for post-administration requirement to reduce exposure rates to the public and document compliance
      1. Oral and written instructions given to patient.
         a. 2 copies of written instructions
            i. Chart copy signed by patient
               1. receipt of document noted in final patient report
            ii. Patient copy reviewed with patient and/or family member:
1. I-131:
   a. Maintaining appropriate distance from others
   b. Separate sleeping arrangements
   c. Minimize time spent in public places
   d. Precautions to reduce the spread of contamination including urine and other body fluids
   e. Effective contraceptive methods
   f. Length of time for each precaution

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

9. Calculate and administer appropriate therapeutic dosage based upon 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.
      i. Recent radioiodine uptake or qualitative thyroid scan
      ii. Thyroid hormone levels
      iii. Delivered activity
      iv. Fixed dose regimen based on disease
   b. Calculate radionuclide therapy dose for malignant thyroid disease, basing dose selection on accepted standards.
      i. Post-operative ablation
      ii. Treatment of presumed thyroid cancer in the neck or mediastinal lymph nodes
      iii. Treatment of distant metastases
      iv. Dosimetrically determined thyroid calculations; customize dose levels from body clearance times
      v. External beam therapy plus I-131 for bone disease
   c. Calculate radionuclide therapy dose for palliative bone therapy, basing dose selection on accepted standards.
      i. Based on whole body bone imaging study
      ii. Sr-89
         1. Dose
         2. Route of administration
      iii. P-32
1. Dose
2. Route of administration
   iv. Sm-153
      1. Dose
      2. Route of administration

d. Calculate radionuclide therapy dose for non-Hodgkin’s lymphoma, basing dose selection on accepted standards.
   i. Based on diagnostic whole body biodistribution scan
   ii. I-131 – dose calculations based on:
       1. Platelet counts
       2. Total body residence time
       3. Activity time using body mass to calculate
   iii. Y-90 – dose calculations based on:
       1. Patient’s weight
       2. Platelet count

e. Calculate radionuclide therapy dose for polycythemia, basing dose selection on accepted standards.
   i. Extent of disease
   ii. Weight
   iii. Blood counts
   iv. Typical doses

f. Calculate radionuclide therapy dose for malignant effusion, basing dose selection on accepted standards.
   i. Based on depth in tissue, activity administered and uniformity of distribution:
      ii. Intraperitoneal dose range
      iii. Intrapleural dose range
   iv. Radiosynoviorthesis – dose based on size of joint, depth of tissue, administered activity and uniformity of distribution:
      v. Proximal interphalangeal joints
      vi. Knee joints – 5-6 mCi is typical

g. Calculate radionuclide therapy dose for selective internal radiation therapy (SIRT), basing dose selection on accepted standards.
   i. Tumor volume from CT
   ii. Liver size
   iii. Lung shunting

10. Order or facilitate adjunctive pharmaceuticals for radiotherapy according to protocol.
    a. Rituxan
    b. SSKI
    c. Thyrogen

11. Ensure appropriate laboratory work has been completed prior to treatment.
    a. CBC
    b. TSH
    c. Serum HCG
12. Report procedure to 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 prior to, 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

13. In conjunction with referring and supervising physician, monitor patient and provide post therapy intervention as needed for adverse side effects.
   a. Bone marrow suppression
   b. Supportive care for symptoms
      i. Pain management
      ii. Nausea
      iii. Fatigue
      iv. GI disturbance

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.

1) Administer radiopharmaceuticals for radionuclide cisternography, cerebrospinal fluid shunt evaluations, cerebrospinal fluid leaks or for intraperitoneal procedures using aseptic technique and radiation safety standards at the discretion of the supervising physician
   A) Explain complete procedure to 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.

2) 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.
      i) Impaired coagulation
      ii) Poor window to biopsy site
   D) Identify appropriate instruments and use according to recommended standards of practice.
   E) Prepare biopsied tissue for pathological 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.
   i) Pneumothorax
   ii) Bleeding
   iii) Unintended damage to surrounding structures due to extravasations
J) Advise patient of needed follow-up care.

3) **Manage pain and sedation for patients 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.
Overview for the Nuclear Cardiology Curriculum

The knowledge and skills of Nuclear Medicine Advanced Associates 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 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, ECG and image interpretation, 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 interpretation, outcomes management, and advanced life support.
Clinical Nuclear Medicine:  
Cardiology Competencies and Content

14. Successfully complete and maintain Advanced Cardiac Life Support credentialing.
   
a. Assess normal ECG to determine patient safety for stress testing.
   i. Identify the leads are associated with the various arteries and walls of the heart.
   ii. Understand the conduction systems within the heart.

b. Assess abnormal ECG conduction in preparation for stress testing.
   i. New or old left bundle branch block
   ii. New or old ST elevations or ST depressions

15. Develop procedural policies and standards for pre-cardiac 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.
   i. Lightheadedness
   ii. Dizziness
   iii. Fainting
   iv. Near syncope
   v. Palpitations
   vi. Chest pain
   vii. Diaphoresis
   viii. Chest pressure
   ix. Arrhythmic heart beats
   x. Shortness of breath
   xi. Nausea/vomiting
   xii. Disturbances in vision
   xiii. New onset of confusion
   xiv. Changes in level of consciousness (LOC)
   xv. Hypo or hypertension (unstable patient)

b. Follow a step-by-step course of action for patients who develop asymptomatic bradycardia or tachycardia while in office (before, during or after stress test).
   i. Immediately stop the stress test, if applicable
   ii. Administer appropriate oxygen therapy
   iii. Obtain intravenous access, if applicable
   iv. Assess vital signs frequently (i.e., blood pressure as required)
   v. Activate cardiac assistance team if necessary Call 911, if applicable
c. Follow a step-by-step course of action for patients who develop signs and symptoms of bradycardia or tachycardia while in office (before, during or after stress test).
   i. Immediately stop the stress test, if applicable
   ii. Place patient flat on floor
   iii. Elevate lower extremities above heart
   iv. Administer appropriate oxygen therapy
   v. Obtain intravenous access
   vi. Initiate intravenous fluid bolus of normal saline (NS) or lactated ringers (LR)
   vii. Obtain blood sugar level if appropriate
   viii. Activate cardiac assistance team if necessary Call 911, if applicable

d. Identify the proper medications and dosages for stable cardiac rhythms.
   i. Bradycardia
      1. Atropine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
   ii. Sinus tachycardia
      1. Normal saline or lactated ringers
         a. Usual dose
         b. Maximum dose
         c. Dose rate
   iii. Narrow complex tachycardia of unknown etiology or supraventricular tachycardia (SVT)
      1. Adenosine (therapeutic)
         a. Usual dose
         b. Maximum dose
         c. Dose rate
      2. Calcium channel blockers
         a. Diltiazem
            i. Usual dose
            ii. Maximum dose
            iii. Dose rate
         b. Verapamil
            i. Usual dose
            ii. Maximum dose
            iii. Dose rate
   3. Beta-blockers
      a. Metoprolol
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
      b. Labetalol
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
4. Amiodarone
   i. Usual dose
   ii. Maximum dose
   iii. Dose rate
iv. Narrow complex tachycardia of unknown etiology or supraventricular tachycardia (SVT) non-medicine.
   1. Valsalva maneuver
   2. Ice to face
   3. Blow into an occluded straw
   4. Carotid massage
v. Atrial fibrillation/atrial flutter
   1. Diltiazem
      a. Usual dose
      b. Maximum dose
      c. Dose rate
   2. Beta-blockers
      a. Metoprolol
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
      b. Labetalol
         i. Usual dose
         ii. Maximum dose
         iii. Dose rate
   3. Amiodarone
      a. Usual dose
      b. Maximum dose
      c. Dose rate
vi. Ventricular tachycardia - monomorphic etiology
   1. Amiodarone
      a. Usual dose
      b. Maximum dose
      c. Dose rate
   2. Lidocaine
      a. Usual dose
      b. Maximum dose
      c. Dose rate
d. Use lidocaine only if amiodarone not available or patient is allergic to amiodarone.

vii. Ventricular tachycardia – polymorphic etiology
   1. Magnesium
      a. Usual dose
      b. Maximum dose
      c. Dose rate
   2. Amiodarone
      a. Usual dose
      b. Maximum dose
      c. Dose rate
   3. Lidocaine
a. Usual dose  
b. Maximum dose  
c. Dose rate  
d. Use lidocaine only if amiodarone not available or patient is allergic to amiodarone  

e. List contraindications and precautions of common cardiac medications.  
   i. Atropine  
      1. Myocardial infarct  
      2. Ventricular escape rhythm (HR<40 with wide complex)  
   ii. Calcium channel blockers  
      1. Wolff-Parkinson-White (WPW)  
      2. Lown-Ganong-Levine (LGL)  
      3. Sick sinus syndrome (SSS)  
   iii. Beta blockers  
      1. Wolff-Parkinson-White (WPW)  
      2. Sick sinus syndrome (SSS)  
      3. Heart block, 2\textsuperscript{nd} and 3\textsuperscript{rd} degree  
   iv. Verapamil  
      1. Wolff-Parkinson-White (WPW)  
      2. Lown-Ganong-Levine (LGL)  
      3. Sick sinus syndrome (SSS)  
      4. Poor LV (left ventricular) function (EF< 30\%)  
   v. Adenosine  
      1. Known or suspected bronchoconstrictive or bronchospastic lung disease  
      2. Poor LV function  
   vi. Amiodarone  
      1. Myocardial infarction  

f. Follow a step-by-step approach to handling an ST elevated myocardial infarction (STEMI).  
   i. Oxygen 2 to 4L nasal cannula  
   ii. Aspirin 325mg (non-EC aspirin) or 2 to 4 81mg chewable aspirins  
   iii. Nitroglycerin 0.4mg tablets every 5 minutes for maximum of 3 tablets or 3 nitro-sprays  
   iv. Morphine  

g. Follow a step-by-step approach to handling a stroke situation.  
   i. Provide proper oxygen therapy  
   ii. Obtain intravenous access  
   iii. Determine precise time of symptom onset  
   iv. Perform Cincinnati Pre-hospital Stroke Scale  
      1. Facial droop (ask patient to show teeth and smile)  
      2. Arm drift (ask patient to extend arms, palms down, with eyes closed  
      3. 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.
   i. Exercise induced hypotension or hypertension
   ii. Vaso-vagal
   iii. Asystole
   iv. Ventricular tachycardia

i. Identify and delegate personnel to perform various tasks in preparation for cardiac emergencies.
   i. Crash cart checks: see competency #5
   ii. Required training or drills

j. Incorporate the appropriate federal, state, and institutional guidelines into departmental policies and procedures.

16. 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 IV access.

b. Identify and administer the appropriate medications for commonly occurring cardiac arrhythmias under the direction of the supervising physician.
   i. Asystole
      1. Epinephrine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
      2. Atropine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
   
   ii. PEA
      1. Epinephrine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
      2. Atropine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
   
   iii. Ventricular fibrillation
      1. Epinephrine
         a. Usual dose
         b. Maximum dose
         c. Dose rate
      2. Vasopressin
a. Usual dose  
b. Maximum dose  
c. Dose rate  

3. Amiodarone  
a. Usual dose  
b. Maximum dose  
c. Dose rate  
d. Use only if amiodarone not available  

4. Lidocaine  
a. Usual dose  
b. Maximum dose  
c. Dose rate  
d. Use only if amiodarone not available  

iv. Pulseless ventricular tachycardia  
1. Epinephrine  
a. Usual dose  
b. Maximum dose  
c. Dose rate  

2. Vasopressin  
a. Usual dose  
b. Maximum dose  
c. Dose rate  

3. Amiodarone  
a. Usual dose  
b. Maximum dose  
c. Dose rate  

4. Lidocaine  
a. Usual dose  
b. Maximum dose  
c. Dose rate  
d. Use only if amiodarone not available  

c. Perform cardiac compression or defibrillate patient if required.  
i. Placement location of defibrillating pads on a patient needing to be cardioverted, defibrillated or transcutaneously paced  
ii. Manual and automated defibrillators  
iii. Cardiac compression methodology  

d. Facilitate the ordering of labs or other tests as needed for a cardiac arrest event under the direction of the supervising physician.  
i. Required lab work  
  1. CBC (complete blood count)  
  2. Chemistry (Chem-7, SMA-7, BMP, etc)  
  3. Cardiac enzyme markers (troponin, CK-MB)  
  4. Protime and Partial Protime (PT, PTT, INR)  
  5. Arterial pO2  
ii. EKG  

e. Facilitate admission of patient to hospital if necessary.  

17. Provide indicated intervention for non-cardiac emergency events.
15 May 2008

a. Diabetic patient
   i. Obtain blood sugar
   ii. Indications for administering oral medications/food versus intravenous dextrose

b. Respiratory distress
   i. Oxygen
   ii. Medications as needed

c. Panic attack
   i. Relaxation techniques
   ii. Medications as needed

18. Manage crash cart for compliance.

a. Follow the appropriate guidelines in implementing regulation for managing the department’s crash cart.
   i. Institution
   ii. Federal
   iii. State
   iv. Joint Commission
   v. AHA

b. Inventory crash cart components according to institutional policy.
   i. Personnel responsible for checking the crash cart
   ii. Frequency of checks
   iii. Items checked
      1. Testing the defibrillator
      2. Medications
      3. Pads on the crash cart
      4. Portable oxygen tank level
      5. Security lock

c. Properly dispose of expired drugs.

d. Replace expired drugs.

e. Perform quality assurance testing on defibrillator and document results.

19. Take comprehensive patient history and evaluate for patient pathology.

a. Interview patient and document on department form a complete past and current cardiac history.
   i. Height and weight
   ii. Medication history

   iii. Family history of known cardiovascular disease
      1. Acute Syndromes
      2. Chronic Syndromes
3. Heart Failure
   iv. Patient history of related disorders
      1. Hyper/hypotension
      2. Thyroid disorders
      3. Diabetes
      4. Stroke
      5. Previous thoracic surgery and/or cardiac intervention
      6. Tobacco abuse
      7. Metabolic syndrome
      8. Glaucoma
      9. Chest/ back/ jaw pain
     10. Dyspnea
     11. New onset of fatigue
     12. Dyslipidemia.

b. Establish NPO compliance.

c. Evaluate ambulatory ability.

d. Review non-cardiac history for prevalence to study requested.

e. Perform physical assessment
   i. Heart sounds
   ii. Lung sounds
   iii. Blood pressure and heart rate

20. Evaluate patient laboratory biochemical markers relevant to cardiac pathology.

a. Review most recent laboratory test results relevant to cardiovascular diseases.
   i. Relevant laboratory tests
      1. Urine Tests
         a. Glucose Content
         b. Presence of albumin or blood cells
         c. pH
         d. Pregnancy
      2. Blood Tests
         a. Cholesterol
            i. HDL
            ii. LDL
         b. Hemoglobin values
         c. Hematocrit Values
         d. Leukocyte Count
         e. Serum Chemistries
         f. Blood Urea Nitrogen (BUN)
         g. Creatinine

         h. Serum Electrolytes
            i. Calcium
ii. Potassium

iii. Sodium

i. Serum Enzymes
j. Creatine Phosphokinase (CPK)
k. Serum Glutamic Oxaloacetic Transaminase (SGOT)
l. Lactic Dehydrogenase
m. Glucose
n. Thyroid
o. Serum troponin levels

ii. Normal and abnormal results

iii. Relationship to cardiovascular disease

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

21. Evaluate patient medications for contraindications to stress testing.

a. Understand contraindications to each type of stress test and evaluate for each.
   i. Contraindications to exercise Testing
      1. Absolute
         1. Acute myocardial infarction (within 2 d)
         2. Unstable angina not previously stabilized by medical therapy
         3. Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
         4. Symptomatic severe aortic stenosis
         5. Uncontrolled symptomatic heart failure
         6. Acute pulmonary embolus or pulmonary infarction
         7. Acute myocarditis or pericarditis
         8. Acute aortic dissection
      2. Relative
         1. Left main coronary stenosis
         2. Moderate stenotic valvular heart disease (emphasis on aortic stenosis)
         3. Electrolyte abnormalities
         4. Severe arterial hypertension
         5. Tachyarrhythmias or bradyarrhythmias
         6. Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
         7. Mental or physical impairment leading to inability to exercise adequately
         8. High degree atrioventricular block.
      ii. Contraindications to adenosine
         1. Second or third degree AV block (except in patient with a functioning artificial pacemaker)
         2. Sinus node disease, such as sick sinus syndrome or symptomatic bradycardia (except in patients with a functioning artificial pacemaker)
         3. Known or suspected bronchoconstrictive or bronchospastic lung disease (e.g. asthma)
         4. Known hypersensitivity to adenosine
         5. Use of methylxanthines
      iii. Contraindications to dipyridamole
         1. Known sensitivity to dipyridamole
         2. Known sensitivity to aminophyllin
3. Use of medications containing methylxanthine
4. Unstable angina
5. Acute myocardial infarction
6. Severe asthma or bronchospasm
7. Hypotension
8. Caffeine within 12-24 hours
   iv. Contraindications to dobutamine (Bedford Laboratories packet insert)
   1. Idiopathic hypertrophic subaortic stenosis
   2. Hypersensitivity to dobutamine
   3. Cardiac arrhythmias

b. Review patient medications for contraindications to exercise stress testing.
   i. Evaluate medications and understand how they can affect the response to and interpretation of exercise or pharmacologic stress testing.
   ii. Recognize the effect medications can have on HR, BP, contractility, LVEFP.
   iii. Know recommendations for length of time to discontinue medication if necessary.
   iv. Relevant medications
      1. Antiarrhythmics
      2. Beta blockers
      3. Calcium channel blockers
      4. Inotropics
      5. Vasoactive
      6. Diuretics
      7. Analgesics
      8. Caffeine containing medications
      9. Theophylline
      10. Inhalers
      11. Nitrates

c. Conduct preoperative evaluation for orthopedic or other surgery.
   i. COPD
   ii. LBBB
   iii. Pacemaker/AICD

22. 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.
   i. Autonomy, veracity and confidentiality
   ii. Who may give consent
      1. Competency issues
      2. Minors and mentally impaired adults
   iii. Types of consent
      1. Express
2. Implied by law
3. Informed consent

iv. Components of valid informed consent
1. Procedure that will be done
   a. Diagnosis
   b. Nature or purpose of the treatment or procedure.
2. The name and qualifications of the person doing the procedure.
3. The consequences or expected outcome.
4. The risks involved, except for the very remote.
   a. Exceptions: risk of death or sterility, if applicable
5. The alternatives to this procedure must be discussed
   a. Includes alternative of doing nothing
   b. Must then disclose the patient's prognosis

v. Responsibilities of physician and health care providers
vi. When consent becomes invalid
1. The procedure exceeds the consent given
2. Inadequate information is given to the patient.
3. The nurse or technologist answers medically related questions.
4. The patient is given the consent form and told that it is just “routine papers”
5. There is a force of circumstances
6. There is a change of circumstances.

b. Determine capability of patient to give informed consent.

c. Explain procedure to the patient, including all components of a valid informed consent.
   i. List precautions used to reduce risks
   ii. Review the confidentiality policy
   iii. Answer any questions or direct questions to the appropriate health care professional

d. Obtain the patient’s or guardian’s signature.

23. Conduct treadmill testing per all protocol options under the direction of the supervising physician.

a. Prepare patient for exercise protocol.
   i. ECG preparation
      1. Skin preparation
      2. Electrode placement
   ii. IV establishment

   iii. Baseline readings
      1. Blood pressure
         a. Normal
         b. Abnormal
      2. ECG tracings
         a. Normal
b. Abnormal

b. Determine type of exercise stress test.
   i. Exercise equipment options
      1. Treadmills and monitors
      2. Bicycle ergometer
   ii. Protocol options
      1. Bruce
      2. Modified Bruce
      3. Naughton
      4. Patterson
      5. Ramp
      6. Isometric
      7. Pharmacologic

c. Monitor EKG tracings and blood pressure for specific pathology and cardiac events during stress testing.
   i. Normal responses to exercise
      1. ST-Segment changes
      2. T-wave changes
   ii. Arrhythmias
   iii. Hypotensive/hypertensive response
   iv. Nondiagnostic EKG

d. Use the appropriate termination protocols.
   i. Absolute indication for termination
   ii. Relative indication for termination

e. Calculate the Duke Treadmill Score.
   i. Methodology
   ii. Risk stratification
      1. Low
      2. Moderate
      3. High

24. Prescribe and administer interventional drugs for pharmacological stress under the direction of the supervising physician.

   a. Explain the indications and contraindications for each pharmacologic stress agent.
      i. Adenosine
      ii. Dipyridamole
      iii. Dobutamine

   b. Identify the physiological action of each pharmacologic agent as it relates to stress-testing.
      i. Expected or normal responses
      ii. Abnormal responses
c. Calculate total dose, volume, and dose rate for each of the most common pharmacological 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 patients appropriately in the event of an adverse effect.
   i. Possible side effects
   ii. Treatment of side effects

25. Analyze results of the stress test and imaging portion of the examination and prepare a comprehensive report for the supervising physician.

a. Create a comprehensive report detailing the results of the stress portion of the test.
   i. Indications and patient demographics
   ii. Methodology
      1. Exercise time
      2. Maximum heart rate
      3. Blood pressure
      4. Symptoms
      5. Tolerance (exercise reserve)
   iii. Findings
      1. PQRST Changes
      2. Ectopy
      3. T-Wave abnormalities
      4. Affected leads
      5. Dysrhythmia
         a. Tachycardia
         b. Bradycardia
         c. Blocks
      6. Physiologic responses
   iv. Risk Assessment: Duke Treadmill Score
   v. Validity of examination
   vi. Conclusion with clinically relevant comments.

b. Examine rotating raw data from both stress and resting image acquisitions and evaluate image quality.
   i. Upward creep
   ii. Contamination
   iii. Body habitus
   iv. Motion
   v. Patient exceeds field of view

c. Review data for incidental finding outside of the heart.
   i. Tumor uptake
ii. Enlarged viscera
iii. Halo patterns around heart
iv. Breast uptake
v. Liver uptake
d. Compare and contrast stress vs. resting processed images for perfusion defects.
   i. Enlarged right ventricle
   ii. Enlarged left ventricle
   iii. Evaluate chamber volume data
e. Determine if the heart-to-lung ratio and TID are abnormal.
   i. Normal values
   ii. Abnormal values
f. Evaluate the wall motion of stress and resting images for ejection fraction and kinetic abnormalities.
   i. Dykinesis
   ii. Akinesis
   iii. Hypokinesis
g. Review and evaluate bull’s eye polar maps and summed stress scores.
   i. Normal values
   ii. Abnormal values
h. Create a comprehensive report detailing the results of the imaging portion of the test.
   i. Indications
   ii. Patient demographics
   iii. Dosing information
   iv. Imaging parameters
   v. Findings
   vi. Conclusion.
      1. Normal
      2. Abnormal
      3. Ejection fraction
      4. Summed stress score

26. 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 complimentary diagnostic procedures as indicated.
   i. MUGA
   ii. Viability
   iii. Blood Test
   iv. CTA/ Calcium Scoring
   v. PET
   vi. Heart CATH
   vii. ERNA
   viii. MRI

b. Identify the clinical pathways as outlined by the AMA/ACC for cardiac disease.
   i. Cardiac intervention
      1. Stents
      2. By-pass
      3. Angioplasty
         a. Drug eluting
         b. Non-drug eluting.
   ii. Medication adjustments
   iii. Risk factor modification and life style changes
   iv. Surgical intervention
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, three 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 (e.g., 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 life-long process. It is anticipated that the competencies in this section will be demonstrated in the clinical setting as well as the traditional classroom setting. NMAA educators will most likely provide instruction through modeling behavior, role playing, observation and mentoring through intervention.
Interpersonal and Communication Skills
Curriculum Content

1) 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 referring physician to assure appropriate examination selection, including actions to be taken if the requested procedure appears to be inappropriate.
   i) Requisition Process
      (a) Receipt of order
      (b) Verification of order
      (c) Appropriateness of indication
      (d) Correlation with history
      (e) Contraindications
   ii) Verbal orders

C) Collaborate with other health care team members to improve service delivery.
   i) Communications regarding
      (a) Patient preparation
      (b) Schedule necessary procedures prior to nuclear medicine procedure
      (c) Secure results of necessary procedures prior to 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
         ♦ To the patient if indicated
         ♦ To the referring physician
   ii) Hand-off of patients in institution
      (a) Standardized method to reduce reducing medical errors
      (b) Aligns with Joint Commission initiatives

2) 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.
   i) Joint Commission
      (a) Accountability for protecting patient information
         ♦ Information collection
         ♦ Information maintenance
         ♦ Use of personally identifiable health information
         ♦ Contractual agreements
            (i) Confidentiality clause
         ♦ Monitoring compliance
         ♦ Demonstrating compliance
            (i) Audits
(ii) External reviews

(b) Consents

♦ Informed
♦ Specific
♦ Voluntary
♦ Release of information
  (i) Purposes
  (ii) Types of information released
  (iii) Recipients of information

(c) Education regarding policies, rights and responsibilities

♦ Patient education
♦ Provider education

ii) Patient information standards

(a) Privacy issues

♦ HIPAA goals
  (i) Uniformity of electronic data interchange
  (ii) Confidentiality of electronic health data

♦ Parties HIPAA regulations apply to
  (i) Health care providers
  (ii) Health plans
  (iii) Health care clearinghouses

♦ Parties not covered by HIPAA regulations

♦ Electronic transactions and code sets
  (i) Technical standards
    1. Formats
    2. Data content
  (ii) Electronic transactions
    1. Claims/referral inquiry and submission
    2. Eligibility inquiry
    3. Financial transactions

(b) Privacy standards

(c) Security standards

♦ Physical and technical safeguards for the storage and transmission of protected health information

♦ Unique identifiers
  (i) Providers
  (ii) Employers
  (iii) Health plans
  (iv) Individuals

♦ Electronic digital signature

(d) Enforcement

♦ Centers for Medicaid and Medicare Services (CMS)
♦ Electronic code sets
♦ Office of Civil Rights (OCR)
♦ Privacy standards
♦ State laws and regulations affecting the use and disclosure of health information

(e) Medical informatics

♦ Definition of informatics
♦ Application in medicine
B) Identify potential abuses of confidential patient information.
   i) Information as a commodity
   ii) Potential abuses

C) Describe the challenges associated with maintaining the confidentiality of patient information stored in computer systems and transmitted via networks.
   i) 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
   ii) Provider issues
      (a) Implementation of confidentiality procedures
      (b) Patient education on confidentiality rights
   iii) Managed care organizations
      (a) Information shared with external parties
   iv) Research
      (a) Access to information without breaching patient rights

3) 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.
   i) Skills of good interviewing
      (a) Nonverbal communication
      (b) Facilitation
      (c) Reflection
      (d) Clarification
      (e) Summarization
      (f) Validation
      (g) Empathic responses
      (h) Transitions

   ii) Challenges to the practitioner
      (i) Patient at different ages and comprehension abilities
(j) Situation 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 patient, families, and colleagues.
   i) 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 to 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
   ii) Terminal illness
   iii) Psychological impairment
   iv) Physical impairment

D) Demonstrate effective age-specific and gender-specific communications.

E) Be receptive to the clinical significance of the patient’s personal beliefs and values for adaptation of an exam protocol or departmental policies.
   i) Religion
      (a) Use of blood products in an exam
      (b) Mandatory presence of family member during studies
   ii) Life style (e.g., vegetarians and gastric emptying studies)

4) 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.

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

   A) Potential areas of conflict in the workplace
      i) Harassment in the workplace
      ii) Quid pro quo
      iii) Hostile work environment
      iv) Protected persons
      v) Unwelcome conduct
      vi) Employer’s liability
vii) Sexual harassment
viii) Harassment
ix) Assault and battery
x) Infliction of emotional distress
xi) Invasion of privacy
xii) Wrongful discharge
xiii) Unclear expectations
xiv) Lack of clear jurisdiction
xv) Operational or staffing changes

B) Conflict prevention
   i) Chain of command
   ii) SOP
   iii) Mediation

C) Common resolution strategies
   i) Avoidance
   ii) Fight
   iii) Surrender
   iv) Compromise
   v) Collaborate

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

   A) Medical records
   B) Legal record
   C) Health information systems; informatics;
   D) Quality improvement
   E) Regulatory
   F) Health law/legal

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

   A) Email
   B) Correspondence: letters and memos
   C) Phone conversations
   D) Netiquette

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

   A) Grand Rounds
   B) Presenting lectures/seminars/conferences/posters

9) 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.

10) Apply concepts of teaching and learning theories in design, implementation and evaluation in the education of patient, family, colleagues and the community. (See Practice-based decision making competency domain.)
Overview for the Practice-based Decision Making Curriculum

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, the NMAA will be required to seek out, gather, analyze and act on a combination of quantitative and qualitative data as they work towards 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 things that are done 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 back seat 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 (ACGME) 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

- Track and analyze processes, procedures and outcomes using appropriate statistical and/or qualitative techniques.

1. Use the evidence-based medicine (EBM) process of asking, acquiring, appraising, applying, and assessing to improve clinical practice.
   1. The EBM 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
         ♦ Diagnosis: how to select and interpret diagnostic tests
         ♦ Therapy: how to select treatments to offer patients
         ♦ Prognosis: how to estimate the patient's likely clinical course over time and anticipate likely complications of disease
         ♦ Etiology: how to identify causes for disease
         ♦ Other possible questions (e.g., 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
         ♦ Animal research/laboratory studies
         ♦ Case series/case reports
         ♦ Case control studies
         ♦ Cohort studies
         ♦ Randomized controlled trial
         ♦ Systematic review
         ♦ Meta-analysis
   (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

2. Analyze practice organization and management and perform practice based improvement activities.
   1. Clinical practice evaluation
      (a) Practice demographics
         ♦ Patient demographics
Organization demographics
(i) Location
(ii) Number of exams performed per year
(iii) Number of full-time employees working in department
(iv) Regulatory and accreditation agencies
(b) Customer service (patient/referring physician)
♦ Timing (wait times too long?)
♦ Flow/scheduling (service flow seamlessly or fragmented?)
♦ Accommodation (flexible enough to meet special requests?)
♦ Anticipation (customers’ needs anticipated?)
♦ Communication (communication accurate and timely?)
♦ Customer feedback (know what customers are saying and thinking?)
♦ Organization and supervision (how effective/efficient are procedures and protocols?)
(c) Clinical performance
♦ The performance gap: desired - actual performance
(i) Mission, goals, and vision
(ii) Expectations
(iii) Strategic planning and forecasting
♦ Methods of evaluation
(i) Indirect
  1. Surveys/ratings
  2. Review of records (audits)
(ii) Direct
  1. Observation of real encounters
  2. Observation of simulated encounters
♦ Criteria for performance measures
(i) Relevance
(ii) Understandable
(iii) Measurable
(iv) Formulated in behavioral (observable) terms
(v) Acceptable
♦ Problem-prone departmental performance indicators
(i) Sentinel events
  1. Patient misidentification events
  2. Failure to assess pregnancy status
  3. Failures to recognize and/or respond to changes in patient condition
  4. Medication variances/adverse drug reactions
  5. Infection control
  6. Patient falls and other accidental injury
(ii) Routine events
  1. Obtaining accurate medical history
    a. Effective chart review
    b. Effective patient interview
    c. Effective referring physician interview/follow-up
    d. Effective and complete physical examination (including mental)
  2. Documentation - completeness/accuracy/errors
  3. Patient compliance with preparation guidelines
4. Patient complaints
5. Patient follow-up

♦ Diagnostic accuracy
   (i) Reading films (false positive/false negative rates)
   (ii) Accuracy and completeness of reports

♦ Patient-centered outcomes
   (i) Functional health status
   (ii) Quality of life
   (iii) Satisfaction

♦ Radiation exposure
   (i) Patients
   (ii) Staff

♦ Individual staff performance and development (360 degree evaluation, report cards)
   (i) Adherence to job description
   (ii) Attitude
   (iii) Knowledge and skills
   (iv) Productivity; cost-effectiveness of practice; quality of care
   (v) Accountability
   (vi) Communication skills
   (vii) Cooperation/teamwork

♦ Staff Utilization and development

2. Practice organization and management

(a) Patient medical records (including images and graphics)

(b) Reporting
   ♦ Transcription time
   ♦ Signature time
   ♦ Turnaround time

(c) Scheduling (patient procedures, staffing)

(d) Charge capture and checkout

(e) Medical claims management (coding/reimbursement)

(f) Medical billing & collections

(g) Financial accounting indicators
   ♦ Expenses
   ♦ Days in accounts receivable
   ♦ Cost per relative value unit (RVU)
   ♦ Average RVU per examination
   ♦ Hours worked per RVU
   ♦ Collections by examination
   ♦ Supply cost per RVU

(h) Productivity indicators
   ♦ Examination volume
   ♦ RVUs per FTE employee
   ♦ Gross charges by examination
   ♦ Collections by FTE employee
   ♦ Volume by device

3. Technology assessment

(a) Equipment utilization and patient access

(b) Quality control programs

(c) Maintenance and replacement schedules
3. Develop a personal program of self-study and professional growth.

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

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

2. 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
         ♦ Procedures, actions, and processes permitted for licensed individual
         ♦ Description of what can and cannot be done by licensed individual
            (i) Establishes which activities and procedures represent illegal activity if performed without licensure
            (ii) Includes technical skills that, if done improperly, represent a significant hazard to the patient and therefore must be kept out of the hands of the untrained.
      (b) Purpose
         ♦ Health care goals
            (i) Improve patient care
            (ii) Ensure patient safety
            (iii) Protect the public
         ♦ Legislative goals
            (i) Establishes legislation, rules, and regulations
            (ii) Establishes boundaries between professionals and lay persons
            (iii) Establishes boundaries among different licensed health care professionals
               1. Creates exclusive domains of practice
               2. Creates overlapping domains of practice.
         ♦ Components
            (i) Education
            (ii) Certification
            (iii) Licensure
            (iv) Credentialing
      (c) Source of authority
         ♦ Authority vested by State
         ♦ Defined in law, regulations, or policy documents
         ♦ Establishes Licensing or governing boards
      (d) National or federal considerations in establishing professional guidelines
         ♦ Improves consistency among States’ scopes of practice
         ♦ Facilitates reciprocity or portability
         ♦ Improves professional mobility
         ♦ Promotes consistency of personnel titles
         ♦ Improves the name recognition and public understanding of role of NMAA
         ♦ Establishes standardized curriculum
      (e) Education component
 Establishes appropriate education, clinical experience, and competencies
  (i) Specifies education program accreditation requirements
  (ii) Outlines cognitive, psychomotor and affective learning requirements
 Establishes entry level, advanced level, and mandatory continuing or additional training, practice, or education
(f) Certification component
  ♦ Certification examinations
  ♦ Other demonstrations of competency
(g) Licensure component
  ♦ Permission granted to an individual by the State to perform certain restricted activities
  ♦ Outlines requirements for maintenance of licensure
(h) Credentialing component
  ♦ Definition
    (i) Local process by which an individual is permitted by a specific entity (Medical Director) to practice in a specific setting
    (ii) Varies in sophistication and formality
  ♦ Facility policy: establishes rights and responsibilities within the hospital or healthcare setting
  ♦ Physician delegation: establishes oversight responsibility (e.g., medical direction)
(i) Ethical and legal considerations of licensee
  ♦ Patient and client needs are uppermost
  ♦ Keep up-to-date and continue to develop knowledge, skills and competence
  ♦ Recognize limits to personal knowledge and skill and remedy deficiencies
  ♦ Acknowledge personal accountability
  ♦ Avoid inappropriate delegation
(j) Other variables in scope of practice issues
  ♦ Employer
  ♦ Professional associations
  ♦ Collaborating physician
  ♦ Nurse practice act
  ♦ Medicare provider
  ♦ Insurance carrier
(k) Special considerations
  ♦ Scope of practice variations for special populations
    (i) Pediatric
    (ii) Geriatric
    (iii) Patients with disabilities
    (iv) Patients with limited access to health care for geographic, demographic, socioeconomic, or other reasons
  ♦ Scope of practice variations for specialized practice settings
    (i) Cardiology
    (ii) Oncology
    (iii) Pediatrics
  ♦ Scope of practice variations in non-traditional roles
  ♦ Scope of practice variations during disasters or public health emergencies
(l) Comparisons between NMAA and NMT scopes of practice
2. Standards of Practice

(a) Description
- Define a standard of care and role of practitioner
- Establishes criteria used to judge performance: quality assurance
- Standards established for clinical practice, technical activities and professional responsibilities

(b) Role of standards of practice within work place
- Used to develop job descriptions
- Used to develop departmental policies
- Used to develop performance appraisals
- Used in quality assurance programs as a means of evaluating and improving care.
- Used in medical malpractice or negligence cases regarding accepted standards of care

(c) Standards of practice development
- Developed from research and the actual practices (prevailing practices) of professionals
- Developed from analysis of standards of related professionals
- Developed from established benchmarking programs

- Critically evaluate current literature and extant research to assess the effectiveness of diagnostic and therapeutic procedures.

1. Identify and assess the relevance of and utilize credible sources of information.

i) Scientific literature
   (a) Critically evaluate studies and research to determine the appropriateness of the type of research done and its relative validity
   (b) Reflect on the merits of descriptive vs. explanatory approaches given a specific context and/or construct
   (c) Select the most appropriate research methodology
   (d) meta-analysis
   (e) longitudinal
   (f) random double-blind
   (g) retrospective
   (h) cross-section
ii) Sources of information that patients may commonly access in literature or online

2. 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.

3. 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.

i) 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
   ♦ Human
   ♦ Fiscal
   ♦ Temporal
   ♦ Experiential

ii) 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

iii) Identify the population to be studied

iv) Determine the best approach to sample that population

v) Select the study sample after carefully considering the following factors
(a) Population and sample
   ♦ Random or intentional
   ♦ 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 study’s purpose critically evaluate each of the possible methods for identifying and selecting sample members
   ♦ Random
   ♦ Intentional
   ♦ Convenience

vi) Determine whether to use a Quantitative and/or a Qualitative research approach after considering the following factors
(a) Resource availability
   ♦ Human
   ♦ Fiscal
   ♦ Temporal
   ♦ 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

vii) Contemplate and consider what other types of research might be helpful
viii) 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 study’s findings and conclusions results 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:
   ♦ If appropriate should norm or criterion referenced tests be chosen
   ♦ If performance is being assessed should optimum or typical performance be chosen as the best design for the study
   ♦ Contemplate the overall experimental or study design in order to
(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
   ♦ Basic Concepts of Measurement
     (i) Variables and measurement scales
     (ii) Populations and Samples
       1. Methods of Sampling
       2. Sample Bias
       3. Sample Size
   ♦ Descriptive Statistics
     (i) Organizing and Grouping Data
       (i) Measure of Central Tendency (e.g., mean, median, mode)
       (ii) Measures of Variability (e.g., standard deviation, variance)
   ♦ Measuring Relationships
     (i) Correlation
     (ii) Prediction and Regression
   ♦ Inferential Statistics
     (i) t-test
     (ii) Analysis of Variance
     (iii) Chi-square
   ♦ Interpretation and Use
     (i) Reliability
     (ii) Validity
     (iii) Measurement Error
(j) Be able to analyze, interpret and explain the effects of variance and sample size on the statistical tools and data
• Use feedback and observations to verify that changes were implemented to optimize patient care delivery and outcomes were effective.

1. 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.

2. Utilize these data and their analysis to educate peers and disseminate findings.

3. 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.

4. Carefully monitor the ratio of true positives to false positives in light of the context of the variables that affect these in order to assure that patient care and study quality meets or exceeds expected standards.

5. 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.

• 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, protecting, or deleting sensitive information.

• Provide discipline-specific education to patients, students, colleagues, and the public.

A) Use opportunities to teach and learning as facets of professional practice.
   i) Teaching and learning in human service practice
      (a) formal
      (b) informal
   ii) Learners in human service practice
      (a) Individuals
         ♦ Patients
         ♦ Students
         ♦ Colleagues
         ♦ Other professionals
Other clients
♦ Member of the public
(b) Small groups
(c) Communities
(d) Professional groups

iii) Teachable moments: finding teaching opportunities
(a) Developmental learning opportunities (e.g., common life tasks, role transitions)
(b) Critical learning opportunities (e.g., unexpected crisis)

iv) 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.
i) Viewing patients/clients as learners
(a) Teaching philosophies
♦ Positivism
♦ Constructivism
♦ Stages of Learning
   (i) Dualism
   (ii) Multiplicity
   (iii) Contextual relativism
(b) Styles of learning
♦ Concrete-to-abstract
♦ Active-to-reflective
(c) Principles of effective teaching
♦ Based on the learner's self-concept
   (i) Self-image and self-esteem
   (ii) Need for respect and partnership
♦ Based on the learner's life experience
   (i) Level and context for learning
   (ii) Grafting: understanding the new in terms of the old
   (iii) Enriched communication
   (iv) Sharing learning
♦ Based on the learner's purpose for learning

(d) The resource: select the appropriate resource(s) and conduct search
♦ Types of scientific evidence
   (i) Animal research/laboratory studies
   (ii) case series/case reports
   (iii) case control studies
   (iv) cohort studies
   (v) randomized controlled trial
   (vi) systematic review
   (vii) meta-analysis

♦ Expert opinion
(e) The evaluation: appraise the evidence for its validity and applicability

(f) The patient
   ♦ Return to the patient
   ♦ Integrate evidence with clinical expertise and patient preferences
   ♦ Apply to practice

(g) Self-evaluation: evaluate performance with this patient

ii) 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
      ♦ Telling
      ♦ Instructing
      ♦ Participating
      ♦ Delegating
   (e) Attribute of effective teachers and facilitators
      ♦ Interpersonal skills
      ♦ Expertise
      ♦ Empathy
      ♦ Enthusiasm
      ♦ Clarity and organizational skills
   (f) Sources of influence
      ♦ Coercive influence
      ♦ Reward influence
      ♦ Legitimate influence (role-related influence)
      ♦ Referent influence (based on admiration or personal identification)
      ♦ Expert influence
   (g) Building Credibility
      ♦ Maintenance credibility
      ♦ Organizational credibility
      ♦ Change agent credibility

C) Assess what needs to be learned and demonstrate effective teaching techniques in settings that may be spontaneous or by design.

i) Assessing what needs to be learned
   (a) Pre-formative assessment
   (b) Who identifies learners and learning needs?
   (c) Who perceives the need?
   (d) Assessment strategies
      ♦ Interviews
      ♦ Questionnaires
      ♦ Focus groups
      ♦ Emergent assessment (from shared experience)
      ♦ Embedded assessment

(e) Learning objectives
   ♦ Objective clarification
Objective classification
(i) Cognitive domain
(ii) Psychomotor domain
(iii) Affective domain

Elements of well-stated learning objectives
(i) Who?
(ii) Will do what?
(iii) Under what conditions?
(iv) To what level?

Advantages and limitations of performance-based objectives

(f) Asking Questions

Levels and types of questions
(i) Exploratory
(ii) Challenge
(iii) Relational
(iv) Diagnostic
(v) Action
(vi) Cause-and-effect
(vii) Extension
(viii) Hypothetical
(ix) Priority
(x) Summary

Tactics for effective questioning
(i) Ask one question at a time
(ii) Avoid yes/no questions
(iii) Ask focused questions
(iv) After you ask a question, wait silently for answer
(v) Ask questions that require learner to demonstrate understanding
(vi) Draw out reserved or reluctant learners
(vii) Use questions to change the tempo or direction of discussion
(viii) Use probing strategies

Tactics for handling responses
(i) Actively listen
(ii) Use non-verbal gestures to indicate your attention
(iii) Vary your reaction to students' answers
(iv) Tactfully correct inaccuracies
(v) Ask questions that require learner to demonstrate understanding
(vi) Draw out reserved or reluctant learners
(vii) Use questions to change the tempo or direction of discussion
(viii) Use probing strategies

Teaching effectively – spontaneously and by design
(a) Selecting a delivery method

Face-to-face teaching
Person-mediated distance education (e.g., conference calls)

Program-mediated interactive distance education (e.g., CD-rom, Internet)
Non-interactive distance education (e.g., printed materials)
(b) Sequencing learning activities
- Simple to complex
- Established sequence
- Historical sequence
- Most important to least important
- Most familiar to least familiar
- General to specific
- Concrete to abstract

(c) Planning a teaching episode (using EDICT)
- Explain
- Demonstrate
- Involve
- Coach
- 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) Flip-charts
   (c) Audiovisual materials
      - Videotape
      - Slides and audiotapes
      - Computer-assisted instruction
      - 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.
   i) Performative evaluation
   ii) Formative evaluation
   iii) Summative evaluation
F) Facilitate the transfer of learning.
   i) Types of transfer
      (a) Positive
      (b) Negative
   ii) 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)
   iii) Increasing the probably 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
         ♦ Fine-tuning
         ♦ Trouble-shooting
   iv) 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) Affect of daily biological rhythms on learning and memory
      (f) Intelligence and retrieval
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 healthcare system, self, and the profession. Healthcare 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

1) Demonstrate calm, compassionate, helpful demeanor toward those in need.
   A) Identify forms of help.
      i) Forms of help
         (a) Philanthropic
         (b) Work Related
         (c) Solicited
      ii) Sharing workload
         (a) Unsolicited
         (b) Fulfilling need

2) 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.

3) 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.

4) 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.
   i) Personal Health
   ii) Stress management
   iii) Healthy living

5) 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.
      i) Definition of profession
         (a) Professionalism
         (b) Professional behavior
      ii) 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.
      i) Scope of practice
         (a) As defined by profession
         (b) State regulations and restrictions
         (c) Job descriptions (institutional scope of practice)
      ii) Updating skills

   D) Demonstrate conscientiousness and organization in addressing all professional obligations.
      i) Achieving and maintaining appropriate credentials
         (a) Professional credentialing
         (b) Institutional credentialing
      ii) State licensure
      iii) Continuing Ed
      iv) Regulatory compliance

6) 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.
7) 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.

8) Demonstrate a commitment to medico-legal and ethical principles.

A) Apply the ethical principles of autonomy, non-malfeasance, 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.
Overview for the Systems-based Practice Curriculum

A systems-based practice view is critical to understanding patient outcomes, safety, values and quality. The 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.

The NMAA 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. The NMAA 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

1) 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.
   i) Evolution of health care system in the United States
      (a) Health care development to the 21st century
      (b) Developing role of government
   ii) Health care delivery systems
      (c) Classification
         ♦ Ownership and system affiliation
         ♦ Location
         ♦ Levels of care provided
            (i) Primary
            (ii) Secondary
            (iii) Tertiary
         ♦ Teaching status
      (d) Accreditation
      (e) External influences
      (f) Internal influences
      (g) Administrative structure and governance
      (h) Mission and vision
   iii) 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.
   i) Factors affecting economics of health care
      (a) Entitlement to access
         ♦ Consumer expectations and demands
         ♦ Ethical aspects
      (b) Technology
         ♦ Improved care
         ♦ Improved access
         ♦ Cost of development
         ♦ Cost of use
      (c) Quality
         ♦ Importance
         ♦ Cost
      (d) Legislation
♦ Consumer protection
♦ Cost containment
(e) Payer systems
♦ Shift from retrospective to prospective system
♦ Shift from non-profit to profit based systems
♦ Shift from fee-for-service to diagnostic related groups (DRGs) and capitation
♦ Effects of federal and state regulations
(f) Population
♦ Insured versus uninsured
♦ Age shift
♦ Expense of chronic diseases
(g) Supply and demand
♦ Regional differences in availability and use of services
♦ Competition
(h) Fraud and abuse
ii) Health care delivery and insurance systems
(a) Retrospective fee-for-service system
(b) Medicare and Medicaid
♦ CMS
♦ Original configuration
♦ Development of DRGs
♦ Effects of DRGs on other payer plans
♦ Common Procedural Terminology (CPT), Ambulatory Payment Codes (APC), and International Classification of Diseases, Ninth Revision (ICD-9) codes
iii) Managed care systems
(a) Health maintenance organization (HMO)
♦ Configuration
♦ How costs are controlled
♦ Impact on health care costs
♦ Capitation
(b) Preferred providers organization (PPO)
(c) Physician-hospital organization (PHO)

C) Define and describe a patient population.
i) Patient demographics
ii) Cultural and socioeconomic conditions
iii) Circumstances of living
iv) Health status
v) Epidemiological studies

83
2) Practice cost effective healthcare and resource allocation that do not compromise quality of care.

A) Review and adjust coding practices and procedures to assure optimal and legal reimbursement.
   i) Reimbursement methodologies
   ii) Laws and regulations pertaining to reimbursement.
   iii) Codes for services or exams rendered
   iv) Reimbursement maximization for services provided.
   v) Support documentation for reimbursement for services

B) Analyze departmental budget, cost/revenue for optimal efficiency.
   i) Understanding of accounting and finance practices
   ii) Preparation of a departmental budget
   iii) Assessment of appropriateness of expenditures
   iv) Understanding capital equipment expenditures and depreciation
   v) Determination of staffing needs
   vi) Projecting revenue and expenses
   vii) Recognition of fixed and variable expenses
   viii) Calculation of net income losses and gains
   ix) Preparation of budgetary reports
   x) Aligning resources with expenses

C) Provide documented analysis and data for resource acquisition.
   i) Modality appropriateness assessment
   ii) Business plan development
   iii) Cost benefit analysis
   iv) Preparation of RFPs and RFIs
   v) RFPs and RFIs analysis
   vi) Interpretation of regulatory information
   vii) Interpretation of financial reports and data
   viii) Justification of need
   ix) Comparative analyses

D) Follow filing and documentation practices for practitioner reimbursement as directed by CMS policies and procedures, state, and federal law.
   i) Maintenance of patient records
   ii) CMS policies and procedures
   iii) Documentation for services provided
   iv) Documentation for physician reports
   v) Timely and accurate patient reporting

3) Ensure compliance for 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.
   i) Health care professional credentialing
      (a) Certification
      (b) Licensure
      (c) Registration
   ii) Credentialing agencies
(a) National organizations  
(b) State agencies  
iii) 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  
iv) 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.  
i) Purpose of accreditation  
(a) Quality of care  
(b) Reimbursement  
ii) Health care facility accreditation  
(c) Governmental  
(d) National  
♦ ICANL  
♦ ACR  
(e) State  
iii) Standards of accreditation  

C) Implement Joint Commission standards.  
i) The accreditation process  
ii) Sentinel events  
iii) National patient safety goals  
v) The Joint Commission quality report  
Accreditation participation requirements (APRs)  
vii) Standards, rationales, elements of performance, and scoring  
i) Section 1: Patient-focused functions  
(a) Ethics, fights, and responsibilities (RI)  
(b) Provision of care, treatment, and services (PC)  
(c) Medication management (MM)  
(d) Surveillance, prevention, and control of infection (IC)  
ii) Section 2: Organization functions  
(a) Improving organization performance (PI)  
Leadership (LD)  
iv) Management of the environment of care (EC)  
v) Management of human resources (HR)  
vi) Management of information (IM)  
vii) Section 3: Structures with functions  
vii) Medical staff (MS)  
viii) Nursing (NR)  

4) 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.
   i) Recruitment and staffing programs
   ii) Effective interviewing techniques and procedures
   iii) Staffing ratios
   iv) Retention programs

B) Conduct process for departmental strategic planning per institutional mission.
   i) Demand forecasting through market research
   ii) Implementation of measurable goals and objectives
   iii) Outcomes measurements
   iv) Market position
   v) Alliance development

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

5) 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 (e.g. demographics and socio-cultural 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.
   i) Grand rounds
   ii) Committees internal to the institution
   iii) Interdepartmental projects or reports’
   iv) Interdisciplinary team discussions
   v) Interdisciplinary quality improvement projects
   vi) Accreditation processes
   vii) Community service

6) Describe the major legal mechanisms for oversight and regulation of medical practice, including those related to licensure and discipline, negligence,
malpractice, risk management, doctor-patient relationships, confidentiality, and patient’s rights.

A) Compare civil and criminal law.
   i) Legal issues
   ii) Civil liability
   iii) Intentional torts
        (a) Elements
        (b) Assault
        (c) Battery
        (d) False imprisonment
        (e) Emotional distress
        (f) Fraud
        (g) Invasion of privacy
        (h) Defamation
            ♦ Slander
            ♦ Libel
        (a) Vicarious liability
   iv) Unintentional torts/negligence
        (b) Elements
        (c) Contributory
        (d) Comparative
   v) Criminal law
        (e) Criminal negligence
        (f) Falsification of records
        (g) Drugs
        (h) Fraud
        (i) Patient abuse
        (j) Theft

B) Explain civil procedures.
   i) 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.
   i) Definitions
   ii) Burden of proof
   iii) Res Ipsa Loquitur
   iv) Respondeat Superior

D) Distinguish between the different types of consent.
i) Informed
ii) Uninformed
iii) Implied

E) Understand and comply with the patient’s directives in regard to medical care.
i) Living wills
ii) Do-not-resuscitate orders (DNR)
iii) Power of attorney

F) Comply with employer and employee legal obligations.
i) Labor laws
ii) Unions
iii) Discrimination laws
iv) 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
v) Conditions of employment
   (a) Position descriptions
   (b) Drug screening
   (c) Background checks
   (d) Misrepresentation
vi) Liability coverage
   (a) Employer
   (b) Personal
vii) Equipment safety regulations
viii) Safety
   (a) Hazard identification and control
   (b) Policies and procedures
      ♦ Occupational Safety and Health Administration
      ♦ Centers for Disease Control and Prevention
      ♦ Facility
      ♦ State
   (c) Employee training
   (d) Fire, electrical and chemical safety
   (e) Magnetic fields and radio frequency safety
   (f) Injury prevention
   (g) Safety/quality improvement committees
   (h) Risk management
ix) Whistleblower protection
Pharmacology and Clinical Decision-Making for the Nuclear Medicine Advanced Associate

Description
This content is designed to enhance the nuclear medicine advanced associate’s (NMAA) knowledge of pharmaceuticals commonly used by and given to nuclear medicine 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 NMAA will analyze the patient’s current condition with regards to medications and other therapies and determine the significance to the nuclear medicine procedure. He or she will suggest the appropriate action plan for the procedure for the specific patient. The NMAA 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 NMAA have a clear understanding of the laws and policies related to pharmaceuticals in his or her practice setting.
Conventional Medication Competencies
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.
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.
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 on Accreditation of Healthcare Organizations (JCAHO) 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.
Conventional Medication 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
   F. Implication of USP Chapter <797> Pharmaceutical Compounding

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 combative ness
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. Androgens (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
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.

Contrast Media Competencies
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. lothalamate (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
   3. Procedures requiring the use of oily iodinated media
   4. Contrast used for intrathecal injections
      a. Oily contrast
      b. Aqueous contrast
      c. Patient management to reduce the rate and severity of adverse reactions
5. 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
Radiopharmaceuticals and Interventional Agents

Description
Prior to beginning a nuclear medicine advanced associate program, it is assumed that a nuclear medicine technologist would have a core level of knowledge dealing with the pharmacology of commonly used radiopharmaceuticals and interventional agents. The technologist should also have a clear understanding of the laws and policies related to radiopharmaceuticals in his or her practice setting. At a minimum the technologist should be comfortable with their knowledge of the following information for each radiopharmaceutical or interventional agent.

- Pharmacology
  - Interventional Agents and Radiopharmaceuticals
    - Class of drug
    - Alternate names
    - Indications
    - Mechanism of action
    - Pharmacokinetics
    - Dosage range
    - Precautions and Contraindications
      - Other drugs
      - Pathological conditions
    - Adverse Effects
      - Management
      - Documentation

NMTCB Pharmaceuticals List (March 2006)
Please note: Only generic and/or commonly known drug names are used on the NMTCB examination.

Tc99m Labeled Radiopharmaceuticals
- Mo99m/Tc99m Generators
- Tc99m sodium pertechnetate
- Tc99m oxidronate/HDP
- Tc99m medronate/MDP
- Tc99m pentetate/DTPA
- Tc99m macroaggregated albumin/MAA
- Tc99m sulfur colloid
- Tc99m disofenin/mebrofenin
- Tc99m mertiatide/MAG3
- Tc99m pyrophosphate/PYP
- Tc99m sestamibi/MIBI
- Tc99m tetrofosmin
- Tc99m succimer/DMSA
- Tc99m exametazime/HMPAO
- Tc99m bicisate/ECD
- Tc99m gluceptate
- Tc99m labeled RBCs
- Tc99m denatured radiolabeled RBCs
- Tc99m HMPAO tagged WBCs

Iodine Labeled Radiopharmaceuticals
- I123 sodium iodide
- I131 sodium iodide
- I131 MIBG
I125 serum albumin/RISA
I131 serum albumin/RISA
I125 iothalamate

**Indium Labeled Radiopharmaceuticals**
- In111 chloride
- In111 pentetate (DTPA)Tc99m
- In111 oxine labeled WBCs
- In111 labeled MAB (capromab pendetide)
- In111 pentetreotide
- In111 ibritumomab tiuxetan

**Miscellaneous Diagnostic Radiopharmaceuticals**
- TI201 thallous chloride
- Ga67 gallium citrate
- Xe133 gas
- Cr51 sodium chromate labeled RBCs
- N-13 ammonia
- Rb-82 chloride
- F18 FDG
- N13 ammonia
- Rb82 chloride
- C14 urea

**Therapeutic Radiopharmaceuticals**
- P32 chromic phosphate colloid
- P32 sodium phosphate
- Sr89 chloride
- Sm153 EDTMP lefidronam
- I131 sodium iodide
- Y90 ibritumomab tiuxetan
- I131 tositumomab
- Y90 microspheres

**Interventional Pharmaceuticals**
- dipyridamole
- adenosine
- dobutamine
- aminophylline
- captopril
- enaloprilat
- furosemide
- insulin
- acetazolamide
- cholecystokinen/sincalide/CCK
- morphine
- cimetidine/ranitidine/famotidine

**Miscellaneous Non-Radioactive Agents**
- ACD solution
- heparin
- ascorbic acid
- hetastarch
15 May 2008

contrast media
vitamin B12
Lugol's solution/SSKI
TSH
EDTA
Lidocaine
Lidocaine (EMLA) cream
atropine
recombinant human TSH
Dear Dr. Reid:

The SNMTS, currently a recognized RCEEM, requests ARRT’s approval as a RCEEM+. In a separate letter to the ARRT, the SNMTS announced the establishment of the new nuclear medicine technology advanced level professional, the Nuclear Medicine Advanced Associate (NMAA). The Core Competencies developed for the NMAA was provided with the announcement.

The NMAA core competencies include responsibilities and tasks in existing scopes of practice, knowledge base, and the clinical skills expected of other lateral middle-level providers, primarily Physician Assistants (PA), Radiologist Assistants (RA), and Nurse Practitioners (NP). NMAA’s 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, seeking increased clinical responsibilities and education at an advanced degree level.

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 will 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 at the discretion of the overseeing radiologist or attending physician. Candidates for NMAA programs would be credentialed by the American Registry of Radiologic Technologists (ARRT) and have clinical practice experience deemed appropriate by institutional admissions committees.

The SNMTS Advanced Practice Task Force, chaired by Martha W. Pickett, MHSA, CNMT, has developed the Professional Curriculum Guide, 1st Edition, to be used as a guide for institutions that are initiating advanced level programs. The Professional Curriculum Guide incorporates the NMAA Core Competencies and embraces the core competencies now incorporated into a broad spectrum of health and medical education programs throughout the US and Europe. The six competency domains adopted for the NMAA Professional Curriculum Guide are those developed by the Institute of Medicine, Accreditation Council for Graduate Medical Education, American Board of Medical Specialties, and other organizations: Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Evidence-based Decision Making, Professionalism, and Systems-Based Practice. Patient Care Competencies are described for general nuclear medicine procedures in all settings. Medical Knowledge in clinical nuclear medicine competencies incorporate general nuclear medicine procedures with specialty competences outlined for cardiology, oncology, and therapy. They also include 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 Communication 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. Evidence-based decision-making is the ability to analyze practice experience and perform practice-based improvement activities using a systematic methodology and may involve such activities as quality improvement programs, patient safety programs, or grand round 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 to those assuming administrative tasks.

The University of Arkansas Medical School (UAMS) has joined two other institutions to create a consortium for creating the first Nuclear Medicine Advanced Associate program. UAMS anticipates that consortium will be ready to launch the first NMAA program in either Fall 2008 or, at the latest, January 2009.

The SNMTS currently provides education activities, both VOICE and CME that meet the standards for Category A+ credit. With these high standards already in place, this new program would also meet the requirements of both Radiology Assistants and NMAA’s. According to the ARRT, Category A+ credits are awarded to CE activities that contain advanced level content and are intended for the radiologist extender. All SNM education activities are approved for both physicians and technologists; therefore SNM currently provides advanced level activities to technologists. The SNM’s Lifelong Learning and Self-Assessment Program, for example, meets all the qualifications the ARRT has outlined for Category A+ credit. The SNMTS understands that in order to be considered for Category A+, educational activities must be approved by a RCEEM that has special authorization by ARRT to evaluate such activities.

If recognized as a RCEEM +, the SNMTS will agree to comply with the following criteria: SNMTS will be currently recognized as a RCEEM, the SNMTS will have a thorough understanding of the roles and responsibilities of the Radiologic Technologist, the Radiologist Assistant and the Radiologist, and the SNMTS will be willing to support the philosophy of ARRT CE requirements.

We look forward to your feedback and are hopeful of a positive outcome. If you need any additional information, please do not hesitate to contact myself or Mark Wallenmeyer, SNMTS President-Elect.

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Thank you for your continued support and we look forward to working with you on the new NMAA program.

Sincerely,

David Gilmore, MS, CNMT, NCT, RT(R)(N)
SNMTS President

Mark Wallenmeyer, MBA, CNMT, RT(N)
SNMTS President-Elect
BS Entry Level Task Force
Curriculum Guide for Educational Programs in Nuclear Medicine Technology
4th Edition
The Curriculum Guide for Educational Programs in Nuclear Medicine Technology 4th Edition has been revised to include the expanding and increasingly complex educational content that is necessary for preparing knowledgeable, competent, and qualified entry-level Nuclear Medicine Technologists.

Changes in this edition include the following:

- Increased emphasis on standardized general education requirements
- New sections:
  - Cross-sectional Anatomy
  - Research in Allied Health
  - Emerging Technologies
- Additions:
  - Administration of contrast media
  - Single-photon emission computed tomography (SPECT)/computed tomography (CT), positron emission tomography (PET)/CT, and CT throughout
  - X-ray production and X-ray beam physics
  - Radiation exposure to nuclear medicine patients
  - NUREG-1556, Volume 9, 2002: model procedures
  - Sr82/Rb82 generator
  - Splenic imaging with heat-denatured red blood cells
  - Technegas
  - Radiosynoviorthesis
  - Radiolabeled monoclonal antibody therapy
  - Y-90 microspheres
- Expanded sections:
  - Instrumentation: Counting Statistics
  - Interventional Agents Used in Nuclear Medicine
  - Oncology—separate section
  - Nuclear Cardiology
- Revised in its entirety:
  - Nuclear Physics is now Radiation Physics
- Deletions:
  - Rb81/Kr81m generator
  - Schillings procedures
  - Radioassay
Society of Nuclear Medicine Technologist Section
Recommended Entry-Level Curriculum

Minimum Required General Education Courses
- General Physics (2 semesters or equivalent)
- General Chemistry (2 semesters or equivalent)
- Human Anatomy and Physiology (2 semesters or equivalent)
- College Algebra or higher
- Statistics
- Oral/Written Communications (2 semesters or equivalent)
- Humanities
- Social Sciences

Optional Preparatory Coursework:
- Biology
- Molecular Biology/Cellular Biochemistry
- Genetics
- Pathophysiology
- Immunology
- Biomedical Ethics
- Health Care Management Courses
- General Business Courses
- Medical Terminology
- Advanced Mathematics
- Computer Science

Professional Core Topics
- Patient Care
- Health Sciences Research
- Ethics and Law
- Cross-sectional Anatomy
- Systems-Based Practice
- Medical Informatics

Professional Topics
- Radiobiology
- Radiation Protection
- Radiation Physics
- Instrumentation
  - Nonimaging
  - Counting Statistics
CURRICULUM GUIDE

- Computers
  - Imaging
- Nuclear Pharmacy and Pharmacology
- Diagnostic Procedures
  - Skeletal
  - Cardiovascular
  - Central Nervous System
  - Digestive System
  - Endocrine/Exocrine System
  - Genitourinary System
  - Hematology and In Vitro
  - Respiratory System
  - Infection and Inflammation
  - Oncology
  - Pediatrics
- Clinical Education
- Radionuclide Therapy
- Emerging Technologies
Chapter 1

Minimum Required General Education Courses
The profession of Nuclear Medicine Technology has experienced significant advancements in technology and molecular science. As the field has advanced, the scope of practice for Nuclear Medicine Technologists has increased. The need for critical thinking and the ability to respond to clinical, organizational, and fiscal demands facing the health care industry supports the creation of a multiskilled technologist to perform nuclear medicine imaging studies and provide assistance with radionuclide therapy treatments.

The Society of Nuclear Medicine Technologist Section Entry-Level Curriculum includes a general education core that lists required courses in math, science, and the liberal arts. These courses are intended to prepare students for entry into the professional component of the Nuclear Medicine Technologist Program. Also included is a list of optional preparatory coursework that could further enhance the educational curriculum for any Nuclear Medicine Technology program.

It is the belief of the Society of Nuclear Medicine Technologist Section that the general educational core curriculum will provide Nuclear Medicine Technologist students with the necessary foundation for the successful completion of the professional component of a Nuclear Medicine Technology program.
Chapter 2

Patient Care
Patient Care

As the role of the medical imaging professional continues to expand, more knowledge is needed in all areas. Patient care is no exception. Advanced patient care skills are essential elements of providing high-quality patient care. This section addresses patient care and safety, patient-technologist communication, age-specific needs, emergency care, and venipuncture. All students should be certified in cardiopulmonary resuscitation or basic life support.

Objectives:

1. Demonstrate effective communication and patient interaction
2. Identify, verify, and assess medical records
3. Practice proper patient transport and safety
4. Practice proper infection control techniques
5. Assess, respond to, and manage patient needs
6. Differentiate and perform various routes of radiopharmaceutical and pharmaceutical administration
7. Perform proper phlebotomy techniques
Patient Care

I. Patient Communication and Interaction
   A. Components of communication
      1. Verbal
      2. Nonverbal
      3. Written
   B. Problems in communication
      1. Effects of positive and negative methods of communication
      2. Barriers to effective communication
      3. Confrontational versus nonconfrontational communication
      4. Methods for communicating with patients demonstrating specific behaviors or moods
   C. Communication and interaction with specific groups
      1. Terminally ill
      2. Chronically ill
      3. Cancer
      4. Unconscious
      5. Developmentally or mentally impaired
      6. Physically impaired
      7. Sensory impaired
      8. Non-English speaking
      9. Multicultural
     10. Age-specific
         a. Infant
         b. Toddler
         c. Preschool and grade school
         d. Adolescent
         e. Early adulthood
         f. Middle adulthood
         g. Older adulthood
         h. Late adulthood
   D. Age-specific competency
      1. Developmental changes
      2. Impact of illness
      3. Adaptation to patient’s age-specific needs
         a. Cognitive domain
         b. Affective domain
         c. Psychomotor domain

II. Patient Management
   A. Requisition process
      1. Receipt of order
      2. Verification of order
      3. Appropriateness of indication for procedure
         a. Correlation with history
b. Contraindications
B. Patient identification
C. Patient history
D. Medication reconciliation
E. Explanation of procedure
F. Assessment of the patient's needs as they relate to the procedure

III. Medical Records
A. Purpose
B. Contents and organization
C. Electronic medical record
D. Technologist’s responsibilities
   1. Documentation of procedure
   2. Confidentiality

IV. Patient Transport and Safety
A. Transportation
   1. Body mechanics
   2. Lifting techniques
   3. Transfer techniques
   4. Special considerations
      a. Casts
      b. Traction devices
      c. Intravenous lines and poles
      d. Catheters
      e. Oxygen cylinders and tubing
      f. Chest tubes
      g. Other

   B. Safety
      1. Safety devices for stretchers, scanning tables, wheelchairs
      2. Immobilization techniques
      3. Equipment safety

V. Infection Control
A. General principles
   1. Medical asepsis
   2. Surgical asepsis
B. Infections acquired in the course of medical care
   1. Nosocomial
      a. Iatrogenic
      b. Other
   2. Community acquired
C. Methods and sources of transmission
   1. Direct contact
   2. Aerial route
   3. Fomites
4. Endogenous
5. Blood and blood products
6. Other body fluids

D. Risks to health care personnel
1. Nosocomial infections
   a. Exogenous
   b. Endogenous
2. Blood-borne pathogens
   a. Human immunodeficiency virus and acquired immunodeficiency syndrome
   b. Viral hepatitis
   c. Methicillin-resistant Staphylococcus aureus
3. Airborne pathogens
   a. Tuberculosis
   b. Herpes zoster
   c. Methicillin-resistant Staphylococcus aureus
4. Vectors
   a. Mechanical
   b. Biological

E. Controlling pathogenic contamination
1. Standard precautions
2. Sharps safety
3. Hand-washing techniques
4. Isolation
   a. Direct
   b. Reverse
5. Disinfection and antiseptics
6. Sterilization
   a. Autoclaving
   b. Dry heat
7. Disposable equipment
8. Injury reporting

F. Special techniques
1. Masking, gowning, and gloving for isolation
2. Sterile package opening
3. Sterile field maintenance

VI. Patient Support
A. Patient assistance
1. Dressing and undressing
2. Security of patient property
3. Bedpans, urinals, and diapers
4. Emesis basins
5. Comfort and modesty
6. Psychological support
B. Support equipment
   1. Intravenous lines and pumps
   2. Intravenous catheters
      a. Peripheral inserted central catheter lines
      b. Central line catheter
      c. Other
   3. Urinary catheters
   4. Glucometer
   5. Oxygen delivery regulators
   6. Drainage tubes
   7. Suction devices
   8. Traction devices
   9. Removable and nonremovable braces

C. Vital signs
   1. Pulse
   2. Respiration
   3. Blood pressure
   4. Temperature

D. Emergencies
   1. Nausea and vomiting
   2. Reactions to medications
   3. Reactions to contrast media
   4. Syncope
   5. Seizures
   6. Diabetes-related hypoglycemia
   7. Hemorrhage
   8. Shock
   9. Cardiac/respiratory events
      a. Crash cart
      b. Codes
      c. Electrocardiogram
      d. Basic care life support for health care providers
         i. Signs and symptoms of respiratory or cardiac distress
         ii. Obstructed airway
         iii. Cardiopulmonary resuscitation
         iv. Automated external defibrillator

VII. Routes of Administration
A. Intravenous administration
   1. Site selection
      a. Location of commonly used sites
         i. Arm
         ii. Hand and wrist
         iii. Foot
b. Factors affecting site selection
   i. Procedure requirements
   ii. Lumen size and quality
   iii. Scarring
   iv. Thrombosis
   v. Edema
   vi. Mastectomy
   vii. Loss of sensation
   viii. Arteriovenous fistula for dialysis
   ix. Patient preference

2. Injection supplies
   a. Needle types and gauges
   b. Angiocatheter types and gauges
   c. Types of intravenous tubing
   d. Three-way stopcock
   e. Other standard supplies

3. Patient preparation
   a. Explanation of procedure
   b. Aseptic technique

4. Procedure for intravenous access
   a. Placement of tourniquet
   b. Methods to enhance vessel access
   c. Patient position
   d. Selection of site
   e. Needle position and injection technique
   f. Assurance of free flow
   g. Determination of compatible intravenous fluids
   h. Catheter removal

5. Injecting radiopharmaceuticals and contrast media agents
   a. Manual techniques
      i. Routine injection
      ii. Bolus injection
      iii. Flushes
      iv. Heparin locks
      v. Injection through existing intravenous lines
   b. Automatic techniques
      i. Syringe infusion pumps
      ii. Contrast media injectors
   c. Intravenous flow rates
   d. Complications
      i. Air embolism
      ii. Extravasation
      iii. Adverse reaction
      iv. Thrombosis
      v. Tissue inflammation, damage, and necrosis
      vi. Loss of sensation
6. Proper disposal of used materials

B. Other methods of administration

1. Oral
   a. Aseptic technique
   b. Techniques for assisting patients whom have difficulty swallowing

2. Intramuscular injection
   a. Site selection
   b. Aseptic technique
   c. Injection technique

3. Inhalation
   a. Equipment setup
   b. Administration technique

4. Subcutaneous injection
   a. Site selection
   b. Aseptic technique
   c. Injection technique

5. Intradermal injection
   a. Site selection
   b. Aseptic technique
   c. Injection technique

6. Intrathecal injection
   a. Role of the technologist
   b. Equipment
   c. Maintenance of a sterile field

7. Intracavitary
   a. Role of the technologist
   b. Equipment
   c. Maintenance of a sterile field

C. Contrast media agents

1. Administration of contrast media
   a. Oral
   b. Intravenous
   c. Other

2. Types of contrast media
   a. Iodinated
   b. Noniodinated

3. Iodinated contrast materials
   a. Procedures requiring the use of iodinated contrast
   b. Instructions given to diabetic patients receiving antihyperglycemic agents (eg, metformin)

4. Characteristics of iodinated contrast materials
   a. Water solubility and hydrophilicity
   b. Osmolality
      i. High osmolar contrast media
      ii. Low osmolar contrast media
iii. Ionic versus nonionic
   c. Viscosity
d. Calcium binding
e. Iodine concentration

5. Dose calculations
   a. Indication
   b. Adult versus pediatric
c. Concentration and volume

6. Adverse reactions
   a. Recognition
   b. Treatment
c. Documentation

VIII. Phlebotomy
   A. Procedure
      1. Method of drawing and dispensing samples
      2. Complications
      3. Anticoagulant selection
      4. Types and color coding of evacuated vials
Chapter 3

Health Sciences Research
Health Sciences Research

Research methods are important because the health care profession is continually changing, which requires the Nuclear Medicine Technologist to adapt procedures and practices to the changing environment. The Nuclear Medicine Technologist needs to contribute to the body of knowledge and be able to effectively analyze resources to promote best practice in the profession.

Objectives:

1. Apply the foundations of research methodology
2. Critique and analyze research articles to determine the accuracy and validity of research findings
3. Differentiate between qualitative and quantitative research methodologies
4. Evaluate and apply statistical models in research
5. Compose and present research findings
6. Differentiate and calculate sensitivity, specificity, prevalence, negative and positive predictive value, and accuracy of tests based on results
Health Sciences Research

I. Foundations of Health Science Research
   A. Research concepts applied to health sciences
   B. Types of research
      1. Basic research
      2. Applied research
   C. Evaluation of the literature

II. Identification of a Topic
   A. Identification of a reasonable question
   B. Purpose of the study
   C. Hypothesis of the study

III. Literature Review
   A. Literature search
   B. Resources
      1. Library resources
      2. Computer searches
   C. Organization of material

IV. Refinement of the Research Question
   A. Problem
   B. Background
   C. Purpose
   D. Significance
   E. Research question or hypothesis

V. Components of Research Study
   A. Abstract
   B. Introduction
   C. Methods
   D. Results
   E. Discussion
   F. Limitations
   G. References
   H. Style
   I. Communicating with tables and figures

VI. Research Methods
   A. Qualitative research
      1. Purpose
      2. Types
   B. Quantitative research
      1. Purpose
      2. Types
C. Parameters of a research study
   1. Defining and operationalizing terms
   2. Assumptions
   3. Scope of the study
   4. Limitations of the study
   5. Sampling methods
D. Examples of data collection techniques
   1. Observation
   2. Interview
   3. Written questionnaires
   4. Record and artifact review
   5. Instrumentation
   6. Tests, measures, and inventories
   7. Validity and reliability of test instruments
E. Data analysis
   1. Qualitative
      a. Patterns, categories, and descriptive units
      b. Grounded theory
   2. Quantitative
      a. Parametric data
      b. Interval data
      c. Ratio data
      d. Nonparametric data
      e. Nominal data
      f. Ordinal data
   3. Descriptive statistics
      a. Central tendency
      b. Variability
   4. Inferential statistics
      a. Significant differences
      b. Tests for correlation
      c. Comparison of more than 2 variables
   5. Biostatistics
      a. Sensitivity
      b. Specificity
      c. Positive predictive value
      d. Negative predictive value
      e. Accuracy
   6. Computer analysis
      a. Statistical Package for the Social Sciences
      b. Statistical Analysis System
      c. Biomedical Data Package
      d. Statistical Parametric Mapping MATLAB
      e. Minitab
      f. Other
Chapter 4

Ethics and Law
Ethics and Law

This section focuses on the interaction of Nuclear Medicine Technologists with their patients, coworkers, and community in accordance with ethical standards and laws of the health care professional. Technologists need to interact with and have respect for individuals from different cultures, beliefs, gender orientations, and socioeconomic backgrounds. Legal and compliance issues, scopes of practice, and patients’ rights are addressed.

Objectives:

1. Assess situations to determine if a Nuclear Medicine Technologist performed ethically based on personal, professional, and societal standards within the United States
2. Analyze scenarios to determine if Nuclear Medicine Technologists are working within their scope of practice and using appropriate practice standards
3. Distinguish between the different types of law
4. Outline the legal proceedings and define the burden of proof
5. Appraise a scenario to determine if the Nuclear Medicine Technologist is violating the patient’s rights
6. Differentiate between the employer’s and employee’s legal responsibilities
7. Argue and discuss medical-legal issues
Ethics and Law

I. Ethical Theories/Principles

II. Personal Ethics
   A. Values development
   B. Impact/effect on care
   C. Values clarification
   D. Moral development

III. Professional Ethics
   A. Professional code(s) of ethics
   B. Values conflict

IV. Societal Ethics
   A. Patient rights
   B. Impact on care
   C. Values conflict
   D. Cultural diversity
      1. Cultural beliefs and norms
      2. Societal and individual factors

V. Scope of Practice and Practice Standards

VI. Types of Law
   A. Civil law
   B. Civil liability intentional torts
      1. Assault
      2. Battery
      3. False imprisonment
      4. Emotional distress
      5. Fraud
      6. Invasion of privacy
      7. Defamation
         a. Slander
         b. Libel
      8. Vicarious liability
   C. Unintentional torts/negligence
      1. Standard of care
      2. Contributory
      3. Comparative
   D. Criminal law
      1. Criminal negligence
      2. Falsification of records
      3. Drugs
      4. Fraud
5. Theft

E. Administrative law
   1. Federal
      a. Health Insurance Portability and Accountability Act
      b. Equal Employment Opportunity
   2. State
   3. Local

F. Civil proceedings
   1. Pleading
   2. Summons and complaint
   3. Discovery
   4. Motions
   5. Trial procedure
   6. Evidence
   7. Verdict
   8. Appeals

G. Burden of proof
   1. Res Ipsa Loquitur
   2. Respondeat Superior

H. Patient consent
   1. Implied
   2. Informed
   3. Uninformed
   4. Research (institutional review board)

I. Advanced directives
   1. Living wills
   2. Do-not-resuscitate orders
   3. Power of attorney

J. Employer and employee responsibility
   1. Labor laws
   2. Discrimination law
   3. Harassment in the workplace
      a. Quo 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
   4. Conditions of employment
      a. Position descriptions
      b. Drug screening
c. Background checks
d. Misrepresentation

5. Liability coverage
   a. Employer
   b. Personal
   c. Institutional (students)

6. Equipment safety regulations

7. Facility safety/training

8. Risk management

9. Whistleblower protection

VII. Medical-Legal Issues
   A. Standard of care
   B. Scope of practice
   C. Malpractice
   D. Confidentiality
   E. Euthanasia
   F. False imprisonment
   G. Radiation protection laws
Chapter 5

Cross-sectional Anatomy
Cross-sectional Anatomy

The ability to locate and identify structures in the axial (transverse), sagittal, and coronal planes is critical in all imaging modalities. Volumetric data sets and 3-dimensional reconstruction of the body structures are increasingly important to the critical diagnosis and treatment of diseases. To enhance patient care and assist physicians with the prognosis, Nuclear Medicine Technology professionals must understand cross-sectional anatomy in each of the imaging modalities.

Objectives:

1. Distinguish normal anatomical structures on computed tomography, magnetic resonance imaging, ultrasonography, nuclear medicine, fusion interventional, and cardiac catheterization laboratory images in the transverse axial, coronal, sagittal, and orthogonal (oblique) cross-sectional imaging plane, within the
   a. Head
   b. Neck
   c. Thorax
   d. Abdomen
   e. Pelvis
   f. Body
   g. Extremities and large joints
2. Distinguish common pathologies recorded on multiplanar images
Cross-sectional Anatomy

I. Introduction to Sectional Anatomy
   A. Body planes
      1. Median
      2. Sagittal
      3. Coronal, frontal
      4. Transverse, cross-horizontal
   B. Anatomical directions and positions
      1. Cranial, superior
      2. Caudal, inferior
      3. Anterior, ventral
      4. Posterior, dorsal
      5. Medial
      6. Lateral
      7. Proximal
      8. Distal
   C. Body cavities
      1. Ventral
         a. Thoracic
         b. Abdominopelvic
      2. Dorsal
         a. Cranial
         b. Vertebral

II. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Head
   A. Cranial bones
      1. Frontal
      2. Ethmoid
      3. Parietal
      4. Sphenoid
      5. Occipital
      6. Temporal
   B. Facial bones
      1. Nasal
      2. Zygomas
      3. Maxilla
      4. Mandible
      5. Lacrimal
   C. Temporomandibular joint
   D. Sinuses
      1. Frontal
      2. Maxillary
      3. Ethmoid
      4. Sphenoid
E. Orbit and eye
F. Muscles
G. Vascular structures

III. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Brain
A. Frontal lobe
B. Parietal lobe
C. Temporal lobe
D. Occipital lobe
E. Cerebellum
F. Midbrain
G. Pons
H. Medulla oblongata
I. Thalamus
J. Hypothalamus
K. Limbic system fissures (sulci)
L. Convolutions (gyri)
M. Meninges
N. Ventricles
O. Vascular structures

IV. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Neck
A. Organs
   1. Pharynx
   2. Larynx
   3. Esophagus
   4. Trachea
   5. Thyroid
   6. Parathyroid
   7. Salivary
B. Cervical spine
C. Muscles
D. Vascular structures
E. Lymphatics

V. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Thorax
A. Organs
   1. Lungs
   2. Diaphragm
   3. Heart
   4. Breasts
   5. Thymus
B. Thoracic spine
C. Sternum
D. Ribs
E. Scapulae
F. Clavicles
G. Muscles
H. Vasculature structures
I. Lymphatics

VI. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Abdomen
A. Organs
   1. Liver
   2. Gallbladder and biliary system
   3. Spleen
   4. Pancreas
   5. Stomach
   6. Kidneys and ureters
   7. Adrenals
   8. Intestines
B. Lumbar spine
C. Muscles
D. Vasculature structures
E. Lymphatics

VII. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Pelvis
A. Organs
   1. Bladder/ureters
   2. Colon
   3. Rectum
B. Male organs
   1. Penis
   2. Testes/scrotum
   3. Prostate
C. Female organs
   1. Vagina
   2. Uterus
   3. Cervix
   4. Ovaries
D. Pelvic bones
   1. Ilium
   2. Ischium
   3. Pubis
   4. Sacrum
   5. Coccyx
E. Muscles
F. Vasculature structures
G. Lymphatics

VIII. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Spine
   A. Vertebral column
   B. Spinal cord
   C. Ligaments
   D. Muscles
   E. Vascular structures

IX. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Upper Extremity
   A. Clavicle
   B. Scapula
   C. Humerus
   D. Ulna
   E. Radius
   F. Wrist
   G. Hand muscles
   H. Vasculature structures
   I. Lymphatics

X. Anatomy and Common Pathologies Recorded on Multiplanar Images of the Lower Extremity
   A. Hip
   B. Femur
   C. Patella
   D. Tibia
   E. Fibula
   F. Ankle
   G. Foot
   H. Muscles
   I. Vasculature structures
   J. Lymphatics
Chapter 6

Systems-Based Practice
Systems-Based Practice

As the role of the health care professional continues to expand and systems-based practice continues to evolve, the fundamentals of health care policy and regulations of delivery systems must be understood. Factors for future key health policy and ethical viewpoints regarding the access of health care must be explored.

Objectives:

1. Review and discuss the history and evolution of US health care systems
2. Review and discuss health care institutional economics and organization
3. Discuss and describe the role and function of present-day health care delivery systems
4. Describe the scope of practice of the Nuclear Medicine Technologist in relation to the interprofessional health care team
5. Describe and explore factors affecting the future of health care delivery systems
Systems-Based Practice

I. History of Health Care Delivery Systems
   A. Philanthropic
   B. Private, for-profit, not-for-profit, government
   C. Specialty services
   D. Affiliation: university teaching, community, nonaffiliated
   E. Alternative delivery systems
   F. Managed care

II. Health Care Institutions Economics and Organization
   A. Mission
      1. Vision
      2. Goals
      3. Objectives
   B. Administrative structure and governance
   C. Levels of care provided
      1. Primary
      2. Secondary
      3. Tertiary
   D. Regulatory agencies
      1. State
      2. Federal government
   E. Licensing and accreditation
      1. The Joint Commission
      2. Intersocietal Commission on the Accreditation of Nuclear Laboratories
      3. American College of Radiology
   F. Budgetary management/stakeholder association
      1. Fiscal management
      2. Operations management
      3. Asset management

III. Present-Day Health Care
   A. Managed care model
      1. Health maintenance organization
      2. Preferred providers organization
      3. Physician-hospital organization
      4. Insurance systems
   B. Legislation driven
      1. Patient rights
      2. Health Insurance Portability and Accountability Act
      3. Reimbursement
         a. Third-party payors
         b. Private commercial insurance
         c. Government-controlled reimbursement
d. Diagnostic Related Group (DRG)
f. Ambulatory Payment Codes (APC)
g. Healthcare Common Procedure Coding System (HCPCS)
h. International Classification of Disease, Ninth Revision (ICD-9) codes

4. Consumer demands
   a. Access to information
   b. Access to care
   c. Quality of care
   d. Health care costs

5. Health care team/organization relationships
   a. Professional roles
   b. Scope of practice
   c. Ethical responsibilities
   d. Interactions

6. Changes in the health care environment
   a. Outpatient clinics
   b. Emergency medical clinics
   c. Home health care
   d. Nursing home/assisted living facilities
   e. Telemedicine

IV. Factors Shaping the Future of Health care
   A. Demographics
      1. Aging population
      2. Health care demand
      3. Utilization of acute and long-term care
      4. Ratio of younger to older workers
   B. Technology
      1. Information and health care technology
         a. Picture archiving and communications systems (PACS)
         b. Radiology information systems (RIS)
         c. Digital Imaging and Communications in Medicine (DICOM)
         d. Other
         e. Lifetime Clinical Records
         f. Medical instruments and equipment
      2. Biomedical breakthroughs
         a. Immunology
         b. Brain research
         c. Genetic coding
         d. Other
      3. Changes in delivery and financing of health care
a. Health care costs  
b. Expenditure control  
c. Access to care  
d. Efficacy, effectiveness, and efficiency  
e. Expenditures for prevention versus cure

4. Licensure  
a. Protection of the health care consumer  
b. Licensure and multicredentialing of the professional  
c. Consumer utilization monitoring  
d. Health outcome measures

5. Promotion of health and wellness  
a. Trend toward promotion of good health in our population  
b. Workplace wellness programs  
c. Life span and longevity
Chapter 7

Medical Informatics
Medical Informatics

Medical informatics is essential for the future implementation of clinical system data entry and development. The engaged process of enhancing the student’s knowledge, experience, and training in the creation and utilization of patient data, administration, and medical quality assurance will be the focus of this specialty. Patients, caregivers, and the health care community at large will benefit from the accessibility of ongoing medical information and data into a computerized system. Ongoing health care information and technology for health care delivery systems and subsequent interfacing, in conjunction with mandatory patient-centered documentation for federal, state, regulatory, and credentialing agencies, must be studied and maintained.

Objectives:

1. Apply and practice Joint Commission standards in the health care environment
2. Apply and practice Health Insurance Portability and Accountability Act regulations in the health care environment
3. Recognize the different information systems used in the health care environment and manage patient information appropriately
Medical Informatics

I. The Joint Commission Standards
   A. Accountability for protecting patient information
   B. Consents
   C. Education regarding policies, rights, and responsibilities

II. Health Insurance Portability and Accountability Act
   A. Evolution of Health Insurance Portability and Accountability Act
   B. Impact on health care providers and personnel
   C. Disclosure
   D. Laws and regulations affecting the use of disclosure of health information

III. Patient Information
   A. Patient record
      1. Information systems and standards
         a. Hospital information systems
         b. Radiology information systems (RIS)
         c. Picture archiving and communications systems (PACS)
         d. Radiopharmacy information system
         e. Telemedicine
   B. Physical or electronic medical records content
      1. Elements of proper charting and documentation
      2. Legal ramifications of improper charting and documentation
   C. Ownership and release of the medical record
Chapter 8

Radiobiology
Radiobiology

This section covers the interactions of ionizing radiation with human tissue, its potential effects, and dosimetry. This is background knowledge needed to understand more fully the concepts and importance of radiation protection.

Objectives:

1. Review the characteristics and sources of different types of radiation
2. Differentiate appropriate radiation measurements, including internal and external exposure
3. Distinguish different types of radiation interactions with matter
4. Recognize cellular response of radiation on micro and macro level
5. Discuss the risk-to-benefit ratio of radiation exposure in terms of diagnostic and therapeutic nuclear medicine procedures
6. Recognize factors influencing absorbed dose to the general public and occupationally exposed workers
7. Explain radiation hazards and use protection techniques for pregnant women and breast-feeding mothers
Radiobiology

I. Characteristics of Radiation
   A. Types of ionizing radiation
      1. Alpha
      2. Beta-negative particles (negatrons)
      3. Beta-positive particles (positrons)
      4. Gamma rays
      5. X-rays
      6. Neutrons
   B. Half-life
   C. Energy

II. Sources of Radiation
   A. Environmental
      1. Natural
      2. Man-made
   B. Medical
   C. Occupational

III. Measurement of Radiation
   A. Exposure
   B. Absorbed dose
   C. Dose equivalent
   D. Effective dose equivalent
   E. Cumulative dose

IV. Cell Biology
   A. Cell structure
   B. Molecular components
      1. Water
      2. DNA
      3. Others
   C. Cell reproduction
      1. DNA synthesis
      2. Mitosis
      3. Meiosis
   D. Cell replication cycle

V. Interactions of Radiation with Matter
   A. Direct action
   B. Indirect action
   C. Linear energy transfer
   D. Relative biological effectiveness
   E. Free radicals
   F. Target theory
G. Deterministic versus stochastic effects

VI. Radiation Genetics
A. Causes and effects of genetic mutations
   1. Spontaneous mutation
   2. Mutagenesis
   3. Carcinogenesis
   4. Gene mutations and cancer
B. Effects of radiation on DNA
C. Chromosome and chromatid aberrations
D. Repair versus mutation

VII. Cellular Responses to Radiation
A. Stage of cell replication cycle versus radiosensitivity
   1. Repair mechanism
   2. Apoptosis and suppressor gene p53
B. Consequences of irradiation
   1. Restitution
   2. Division delays and cell synchrony
   3. Interphase death
   4. Reproductive failure
   5. Chromosome stickiness
C. Survival curves
D. Relative biological effectiveness and quality factor
E. Lethal dose (LD)_{50/30} and LD_{100}
F. Oxygen enhancement ratio

VIII. Factors Affecting Cellular Response to Radiation
A. Physical
B. Chemical
C. Biological

IX. Radiosensitivity and Cell Populations
A. Law of Bergonie and Tribondeau
B. Cell compartment categories
   1. Stem
   2. Transitional
   3. Differential
C. Cell populations
D. Cellular repair

X. Tissue and Systemic Responses to Radiation
A. Acute versus late effects
   1. Acute radiation sickness syndrome
B. Total-body irradiation
   1. Hematopoietic syndrome
2. Gastrointestinal syndrome  
3. Central nervous system syndrome  
C. Tissue repair  

XI. Effects of In Utero Irradiation  
A. Radiosensitivity of embryo/fetus  
B. Phases of embryonic/fetal development  
C. Effects of radiation versus phase of development  

XII. Late Effects of Radiation Exposure  
A. Relationship of radiation exposure to specific effects  
   1. Dose versus effect models  
   2. Problems associated with researching radiation-induced effects/disease  
B. Nonspecific life shortening  
C. Genetic effects (spontaneous mutation versus radiation-induced damage)  
D. Carcinogenesis  
E. Cataract formation  
F. Other diseases  

XIII. Radiation doses  
A. Factors influencing absorbed dose from internal sources  
   1. Concentration and organ masses  
   2. Effective half-life  
   3. Physical and chemical characteristics of radionuclide  
   4. Absorbed fraction  
   5. Cross-irradiation  
B. Organ with highest dose (critical organ) and target organs  
   1. Target organs  
   2. Nontarget critical organs  
   3. Gonadal exposure  
C. Absorbed dose calculations  
   1. Bioassay  
   2. Total body counting  
   3. Classic and Medical Internal Radiation Dose methods  
   4. Formulas  
   5. Charts and tables  

XIV. Risk-to-Benefit Ratios  
A. Radiation hazard versus medical need  
B. Medical radiation exposures  
   1. Comparative doses from diagnostic and therapeutic procedures  
   2. Cumulative doses  

XV. Radiation Exposure to Nuclear Medicine Patients
A. Factors affecting dose to individual
   1. Dose administered
   2. Types of radioactive emissions
   3. Physical half-life
   4. Chemical and physical states
   5. Pathologic conditions
   6. Age of patient

B. General dose levels in nuclear medicine
   1. General exposure ranges
   2. Benefit versus risk

C. Hazards and precautions for pregnant women
   1. Sources of irradiation to fetus
   2. Radiosensitivity of fetus
   3. Estimated dose to fetus from nuclear medicine procedures
   4. Actions after exposure

D. Hazards and precautions for breast-feeding mothers
   1. Secretion of radionuclides in breast milk
   2. Hazard to breast-feeding infant
   3. Estimated dose to fetus from nuclear medicine procedures
   4. Precautions

XVI. 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
E. Conference of Radiation Control Program Directors Inc
F. Biologic Effects of Ionizing Radiation Reports
Chapter 9

Radiation Protection
Radiation Protection

This section covers the principles and applications of radiation protection as well as applicable regulations, including an awareness of how to apply the “As Low As Reasonably Achievable” (ALARA) philosophy to ionizing radiation exposure. Individual regulations are also covered in detail in content areas where they apply, such as radiopharmacy, instrumentation, and radionuclide therapy.

Objectives:

1. Describe the characteristics of radiation and define radiation measurement units
2. Identify the agencies and interpret/comply with the appropriate regulations associated with radiation exposure and receipt, use, and disposal of radioactive materials
3. Define radiation exposure limits and apply safe radiation protection techniques in accordance with the ALARA philosophy
4. Utilize appropriate radiation detection and monitoring equipment and evaluate readings
5. Employ the practical and appropriate methods of radiation protection (time, distance, and shielding) and predict exposure levels based on calculations
6. Assess a scenario and utilize proper protocols to prevent a medical event
7. List what constitutes an error, excess exposure, and medical event and employ appropriate course of action
8. Identify and manage radioactive material spills and contamination
9. Describe the Nuclear Medicine Technologists’ role and responsibility in radionuclide therapy procedure
Radiation Protection

I. Characteristics of Radiation
   A. Types of ionizing radiation
      1. Alpha
      2. Beta-negative particles (negatrons)
      3. Beta-positive particles (positrons)
      4. Gamma rays
      5. X-rays
      6. Neutrons
   B. Half-life
   C. Energy
   D. Units
      1. Exposure
         a. Roentgen
         b. Coulomb/kilogram
      2. Absorbed dose
         a. Radiation absorbed dose
         b. Gray
      3. Relative biologic effectiveness and quality factors
      4. Dose equivalent
         a. Roentgen equivalent man
         b. Sievert
      5. Calculations and conversions

II. Regulation of Radiation Exposure and Use of Radioactive Materials
   A. Agencies
      1. Nuclear Regulatory Commission (NRC)
      2. Department of Transportation
      3. Food and Drug Administration
      4. Environmental Protection Agency
   B. Licensing
      1. Federal and state
      2. Institutional licenses
   C. Introduction to regulatory documents
      1. NRC, Title 10CFR20 (Standards for Protection Against Radiation)
      2. NRC, Title 10CFR35 (Medical Use of Byproduct Material)
      3. NRC, Title 10CFR19 (Notices, Instructions and Reports to Workers)
      4. NRC, Title 10CFR71 (Transport of Radioactive Material)
      5. Department of Transportation, Title 49CFR170 (Hazardous Material Training)
      6. NUREG-1556, Volume 9
      7. State regulations
III. Dose and Exposure Limit Recommendations and Regulations

A. Definitions
1. Effective dose equivalent
2. Total effective dose equivalent
3. Deep-dose equivalent
4. Committed effective dose equivalent
5. Shallow-dose equivalent
6. Eye dose equivalent
7. Derived air concentration
8. Annual limit on intake
9. Occupational dose
10. Public dose
11. Restricted area
12. Unrestricted area

B. Occupational limits
1. Whole body total effective dose equivalent
2. Individual organs, except lens of eye
3. Lens of eye
4. Skin or any extremity
5. Summation of internal and external exposures
6. Planned special exposures
7. Minors
8. Embryo/fetus of occupationally exposed worker
9. Emergency exposures

C. Limits for individual members of the public
1. Effective dose-equivalent limits
2. Exposure rate limits for unrestricted areas
3. Family members of radioactive patient

D. ALARA philosophy
1. Principles
2. Recommended levels
3. Radiation protection programs as described in Title 10 CFR 20

E. Restricted and unrestricted areas
1. Exposure rates
2. Access
3. Signage

IV. Radiation Detectors and Monitors

A. Regulations concerning possession of instruments

B. Survey instruments
1. Geiger-Mueller counter
2. Ionization chamber
3. Liquid scintillation counter
4. Well counter
5. Scintillation probe (NaI probe)
C. Personnel monitors
   1. NRC regulations
   2. Thermoluminescent dosimeter
   3. Optically stimulated luminescence
   4. Pocket ionization chamber
   5. Care and use of devices

V. Personnel Monitoring
   A. Regulations
   B. Bioassay following use of radioiodine
   C. Personnel exposure records
      1. Report interpretation
      2. Notification of exposure levels
      3. Prior exposures

VI. Practical Methods of Radiation Protection
   A. Time
   B. Distance
   C. Shielding

VII. Possession of Radioactive Materials
   A. Licensed materials
      1. Radioactive materials for use in humans
      2. Controlled reference sources
      3. Exempt sources
   B. Activity inventory limits
   C. Sealed sources
      1. Regulations
      2. Inventory
      3. Leak tests
   D. Lost sources

VIII. Institutional Oversight According to NRC Regulations
   A. Radiation safety officer
      1. Responsibilities
      2. Training requirements
      3. Delegation of authority
   B. Radiation safety committee
      1. Responsibilities
      2. Composition
      3. Frequency of meetings
      4. Records
      5. Radiation safety program review
   C. Written directive
      1. Radionuclides and dosage
      2. Patient identification
3. Medical event
4. Records

IX. Radiation Safety Procedures
A. Worker protection
   1. Regulations
   2. Posting notices
   3. Radiation safety education
   4. Notification and reports to workers
   5. Workers’ rights
   6. Declaration of pregnancy
B. General safety rules when working with unsealed radioactive sources
C. Use of shields and labels
   1. Regulations
   2. Syringes
   3. Vials
D. Radioactive liquids
   1. Regulations
   2. Preparation of kits and dose ranges
E. Radioactive gases and aerosols
   1. Regulations
   2. Storage of volatiles and gases
   3. Room concentration limits
   4. Negative pressure requirements

X. Protection of the Patient
A. Measurement of dose to be administered
   1. Regulations
   2. Calibration requirements
   3. Instrument requirements
   4. Instrument quality control
B. Labeling of patient doses to be administered
   1. Regulations
   2. Methods
C. Error or excess exposure
   1. Regulations
   2. Definitions
   3. Procedures
D. Medical event
   1. Regulations
   2. Definitions
   3. Procedures

XI. Radioactive Material Packages
A. Receipt
1. Regulation
2. Procedures

B. Shipping
   1. Regulations
   2. Procedures
   3. Labels

XII. Waste Disposal Procedures and Regulation
A. Waste exempt from disposal regulations
B. Decay —in storage
C. Discharge into sewer system
D. Discharge into atmosphere
E. Transfer to authorized recipient

XIII. Contamination
A. Ambient dose rate survey
   1. Regulations
   2. Survey instrument requirements
   3. Survey instrument quality control
   4. Procedures
   5. Action and trigger levels
B. Removable contamination survey
   1. Regulations
   2. Procedures
   3. Action and trigger levels
C. Decontamination of minor spills
   1. Definition
   2. Procedure
D. Decontamination of major spill
   1. Definition
   2. Procedures

XIV. Radionuclide Therapy
A. Regulations
B. Responsibilities of radiation safety officer and authorized user
C. Dose administration
   1. Patient identification
   2. Written directives
   3. Informed consent
   4. Procedure
D. Release and isolation criteria
   1. No restrictions
   2. Limited restrictions
   3. Isolation requirements
E. Limited restrictions
   1. Restrictions
2. Instructions to patient

F. Safety precautions involving patients in radiation-based isolation
1. Nursing instructions
2. Instructions to patients
3. Room preparation and sign postings
4. Contamination control
5. Room decontamination upon discharge
6. Disposal of waste
7. Patient care and control
8. Visitor control
9. Personnel monitoring
10. Nursing precautions and restrictions
11. Bioassay of personnel

G. Measurement of exposure rates
1. Surveys of restricted and unrestricted areas
2. Safe distance markers
3. Calculated nursing time

H. Procedures in case of death, autopsy, or emergency surgery

XV. NRC Rules and Regulations
A. Title 10CFR19
1. Posting of notices to workers
   a. Documents
   b. Location
2. Instructions to workers
3. Notification and reports to individuals
4. Request for inspection
   a. Right
   b. Request
   c. Employee protection

B. Title 10CFR20
1. Radiation protection programs
2. Occupational dose limits
3. Radiation dose limits for individual members of the public
4. Surveys and monitoring
   a. General requirements for surveys
   b. Survey equipment
   c. Conditions requiring individual monitoring of external and internal occupational doses
5. Control of exposure from external sources in restricted areas
6. Respiratory protection and controls to restrict internal exposure in restricted areas
7. Storage and control of licensed material
   a. Security of stored material
   b. Control of materials not in storage
8. Precautionary procedures
   a. Caution signs
   b. Posting requirements
   c. Exceptions to posting requirements
   d. Labeling containers
   e. Exceptions to labeling containers
   f. Procedures for receiving and opening packages

9. Waste disposal
   a. General requirements
   b. Decay in storage
   c. Release into sanitary sewerage
   d. Transfer for disposal

10. Records
    a. Surveys
    b. Prior occupational dose
    c. Individual monitoring results
    d. Dose to individual members of the public
    e. Waste disposal
    f. Form of records

11. Reports
    a. Reports of theft or loss of licensed material
    b. Notification of incidents
    c. Reports of excess exposure
    d. Reports of individual monitoring

C. Title 10CFR35

1. ALARA
   a. Model program
   b. Management commitment
   c. Radiation safety officer
   d. Investigational levels I and II
   e. Methods to meet ALARA goals

2. Radiation safety officer
   a. Responsibilities
   b. Training requirements
   c. Delegation of authority

3. Radiation safety committee
   a. Responsibilities
   b. Composition
   c. Frequency of meetings
   d. Records

4. Quality management program
   a. Radionuclide and dosage
   b. Written directives
   c. Patient identification
   d. Medical event
   e. Program review
f. Records

5. Medical event
   a. Error and excess exposure
   b. Verbal and written reports
   c. Reporting process
   d. Records

6. NUREG-1556, Volume 9, 2002: Model Procedures
   a. Model Training Program
   b. Model Procedure for Calibrating Survey Instruments
   c. Model Procedure for Calibrating Dose Calibrator
   d. Model Personnel External Exposure Monitoring Program
   e. Model Procedure for Checking Equipment Used in Mobile Nuclear Medicine Services
   f. Model Radiation Safety Committee Charter and Radiation Safety Officer Delegation of Authority
   g. Model Program for Maintaining Occupational Radiation Exposure at Medical Institutions ALARA
   h. Model Procedure for Leak-Testing Sealed Sources
   i. Model Rules for Safe Use of Radiopharmaceuticals
   j. Model Spill Procedures
   k. Model Guidance for Ordering and Receiving Radioactive Material
   l. Model Procedure for Safely Opening Packages Containing Radioactive Material
   m. Records of Byproduct Material Use
   n. Model Procedure for Area Surveys
   o. Model Procedure for Monitoring, Calculating and Controlling Air Concentrations
   p. Model Procedure for Radiation Safety During Iodine Therapy over 30 Millicuries
   q. Model Procedure for Waste Disposal
Chapter 10

Radiation Physics
Radiation Physics

This section covers concepts and physical principles that govern radioactivity and the interactions of ionizing radiation with matter.

Objectives:

1. Define and describe basic atomic physics concepts
2. Illustrate modes of radioactive decay and decay schemes
3. Describe and calculate decay of radionuclides
4. Explain production methods of radionuclides and X-rays
5. Describe the characteristics of an X-ray beam
6. Compare and contrast photon and particulate interaction with matter
7. Perform calculations using the attenuation equation
Radiation Physics

I. Basic Review
   A. Definitions
      1. Electromagnetic radiation
      2. Particulate radiation
      3. Ions and ionization
   B. Composition of the atom
      1. Proton
      2. Neutron
      3. Electron
      4. Neutrinos
      5. Antineutrinos
      6. Other elemental particles
   C. Historical contributions
      1. Wilhelm Roentgen
      2. Henri Becquerel
      3. Marie and Pierre Curie
      4. Others associated with early inventions, developments,
         and applications to the field
   D. Electron shells and stability
      1. Terms
         a. Orbital electron
         b. Valence electron
         c. Auger electron
         d. Photoelectron
         e. Conversion electron
      2. Orbital and suborbital
      3. Pauli exclusion principle
      4. Energy states
      5. Periodic table
   E. Nuclear stability
   F. Neutron/proton ratio and the line of stability
   G. Binding energy
   H. Nuclear models
   I. Atomic nomenclature
      1. Symbol notation
      2. Relationship of mass and energy
      3. Mass energy equivalents
      4. Nuclide
      5. Isotopes
      6. Isobars
      7. Isotones
      8. Isomers
      9. Chart of nuclides
II. Modes of Radioactive Decay
   A. Alpha
   B. Beta
      1. Beta minus
      2. Positron
   C. Electron capture
   D. Gamma
      1. Isomeric transition
      2. Internal conversion
   E. Combination modes

III. Radionuclide Decay
   A. Decay equation
   B. Decay constant
   C. Decay factor
   D. Decay schemes
   E. Units of activity
   F. Specific activity
   G. Half-life
      1. Physical
      2. Biological
      3. Effective
      4. Mean
   H. Exponential graphs
      1. Plot of exponential equation
         a. Linear
         b. Semi-log
   I. Determination of half-life from graph

IV. Production of Nuclides
   A. Reactor
   B. Fission
   C. Fusion
   D. Particle accelerator
      1. Linear accelerator
      2. Cyclotron
   E. Generator
      1. Secular equilibrium
      2. Transient equilibrium

V. X-Ray Production
   A. Source of free electrons (eg, thermionic emission)
   B. Acceleration of electrons
   C. Focusing of electrons
   D. Deceleration of electrons
   E. Target interactions
VI. X-Ray Beam
   A. Frequency and wavelength
   B. Beam characteristics
   C. Quality
      1. Quantity
      2. Primary versus remnant
   D. Inverse square law
   E. Fundamental properties

VII. Photon Interaction With Matter
   A. Scatter mechanisms
      1. Coherent
      2. Compton effect
   B. Full absorption mechanisms
      1. Photoelectric
      2. Pair production
      3. Photodisintegration
   C. Secondary radiation
      1. Bremsstrahlung
      2. Characteristic radiation
      3. Auger electrons
   D. Interaction relationships
      1. Energy
      2. Atomic number
      3. Tissue density
   E. Specific ionization
   F. Linear energy transfer

VIII. Particulate Interaction With Matter
   A. Alpha
      1. Excitation
      2. Ionization
      3. Transmutation
   B. Beta minutes particles
      1. Excitation
      2. Bremsstrahlung
      3. Ionization
   C. Positrons
   D. Specific ionization
   E. Linear energy transfer

IX. Attenuation Equation
   A. Linear attenuation
B. Mass attenuation
C. Half-value layer
D. Calculations
Chapter 11

Instrumentation
Instrumentation: Nonimaging

This section includes the principles of operation and quality control for nonimaging instruments, including monitoring equipment, dose calibrators, well counters, uptake probes, liquid scintillation systems, laboratory equipment, and the gamma probe. Laboratory and clinical experience should be included in the learning process.

Objectives:

1. Describe and apply the principles and operation of gas-filled detectors
2. Describe and apply the principles and operation of scintillation detectors
3. Describe and apply the principles and operation of laboratory equipment
4. Demonstrate operation of nonimaging equipment
5. Perform quality control procedures and analyze the results
Instrumentation: Nonimaging

I. Introduction
A. Radioactive decay process
B. Interaction of ionizing radiation
C. Exposure and exposure rate

II. Gas-Filled Detector Systems
A. Principles of operation
   1. Ionization
   2. Excitation
   3. Gas ionization curve
      a. Recombination
      b. Ionization
      c. Proportional and nonproportional
      d. Geiger-Mueller
      e. Continuous discharge
B. Ion chambers
   1. Dose calibrations
      a. Operation
      b. Quality control
         i. Geometry
         ii. Linearity
         iii. Accuracy
         iv. Constancy
   2. Handheld ionization chamber
      a. Dead time
      b. Daily quality control
      c. Appropriate use
      d. Calibration
   3. Pocket dosimeters
C. Geiger-Mueller counter (survey meter)
   1. Dead time
   2. Daily quality control
   3. Types of Geiger-Mueller probes
   4. Appropriate use
      a. Scale settings
      b. Factors that influence observed exposure rate
         i. Dose-response curve
         ii. Probe geometry
   5. Calibration

III. Scintillation Detection Systems
A. Solid scintillation detector (well counter and uptake probes)
   1. Principles of operation
   2. Component parts
a. Crystal
b. Photomultiplier tubes
   i. Photocathode
   ii. Focusing grid
   iii. Dynodes
   iv. Creation of the electron pulse
c. High-voltage power
d. Amplification
   i. Preamplification
   ii. Gain setting
e. Pulse-height analyzer
   i. Single channel
   ii. Multichannel
   iii. Components of an energy peak
   iv. Detection of an energy peak
f. Counters, timers, rate meters
g. Uptake probe
   i. Flat-field collimator
   ii. Isoresponse curve

3. Energy resolution and full width at half of maximum
4. Modulation transfer function
   a. Relation to resolution
   b. Comparison to full width at half of maximum
5. Energy calibration
6. Dead time versus activity
7. Efficiency
8. Pulse height analyzer window determination
9. Effects of geometry
10. Quality control

B. Liquid scintillation systems
   1. Principle of operation
   2. Use of liquid scintillation systems

C. Gamma probe
   1. Principles of operation
   2. Clinical uses
      a. Sentinel node localization
      b. Other uses

D. Future development in nonimaging technology detection

IV. Laboratory Equipment
A. Centrifuge
B. Thermometers
C. Pipettes and automatic pipettors
D. Water baths
E. Refrigerators/freezers
F. Microscope
G. Hemocytometer
H. Glucose meter (glucometer)
Instrumentation: Counting Statistics

This section includes the principles and applications of statistics as they relate to nuclear medicine instrumentation. The learning experience should include laboratory and clinical experience.

Objectives:

1. Analyze and apply statistical data used in Nuclear Medicine Technology
Instrumentation: Counting Statistics

I. Nuclear Medicine Statistics
   A. Precision versus accuracy
   B. Graphing
      1. Linear plots
      2. Semilog plots
      3. Histogram
      4. Time activity curve
      5. Least squares-best fit curve (regression analysis)
   C. Standard deviation
      1. Series of values
      2. Single value
      3. Counting rate
      4. Net counts
   D. Confidence intervals
   E. Levy-Jennings plot
   F. Coefficient of variation (percent standard deviation)
   G. Gaussian and Poisson distributions
   H. Percent error and percent difference
   I. Chi-square test
   J. T-test
   K. Count rate determination
      1. Gross counts
      2. Background counts
      3. Net counts
   L. Determining the number of counts required for statistical significance
Instrumentation: Computers

This section covers the configuration, function, and application of computers and networks in nuclear medicine. Students should have extensive laboratory and clinical experience performing data acquisition, manipulation, and processing.

Objectives:

1. Describe the configuration, function, and application of picture archiving and communications systems (PACS)
2. Acquire, manipulate, and process information using nuclear medicine computer systems
Instrumentation: Computers

I. PACS
   A. Acquisition device
   B. Types of system interfaces
   C. Digital Imaging and Communications in Medicine (DICOM) compatible
   D. Networking and servers
      1. Centralized servers
      2. Distribution servers
      3. Hybrids
      4. Virtual private network
   E. Imaging display
   F. Archiving
   G. Internet
   H. Integration with other systems
      1. Radiology information systems (RIS)
      2. Hospital information systems

II. Nuclear Medicine Computer Systems
   A. Gamma camera/computer interface
      1. Analog-to-digital converters
         a. Purpose
         b. Types
      2. Buffer
      3. Zoom
         a. Magnification versus resolution
         b. Interpolation
   B. Acquisition modes
      1. Types
         a. Frame
         b. List
         c. Multiple gated
         d. Tomographic
         e. Whole body
      2. Matrix types and sizes
         a. Byte versus word
         b. Number and size of pixels
         c. Voxel
      3. Memory requirements
         a. Addresses
         b. Counts per address
   C. Video display systems
   D. Planar filter options
   E. Single-photon emission computed tomography (SPECT)
reconstruction techniques
  1. Back projection
  2. Fourier reconstruction
  3. Iterative reconstruction
  4. Slice-thickness selection
  5. Reorientation
F. SPECT filters
  1. Filter design and selection
     a. Selection criteria
     b. Types
     c. Cutoff
     d. Frequency
  2. Nyquist frequency
  3. Multicamera head reconstruction techniques
G. Data processing programs
  1. Field uniformity correction
  2. Background and foreground correction
  3. Attenuation correction
  4. Motion correction
  5. Contrast enhancement
  6. Scaling and normalization
  7. Image arithmetic
  8. Display manipulations
  9. Dead time corrections
  10. Center of rotation error corrections
  11. Regions of interest
      a. Selection
      b. Comparison ratios and percentages
      c. Effects of poorly drawn regions of interest
  12. Curve generation and manipulation
      a. Image profiles
      b. Time-activity curves
      c. Harmonic analysis
  13. Automatic edge detection
  14. Gray scales
  15. Color scales
  16. Image registration and coregistration
  17. Three-dimensional reconstruction
  18. Polar map generation
  19. Standard uptake values
H. Use of computers in quality control programs
  1. Linearity
  2. Sensitivity
  3. Gain
  4. Analog versus digital conversion
  5. Resolution
6. Spatial distortion
7. Integration with imaging systems
8. Validation of software
9. Radiopharmacy management systems
10. Center of rotation
11. Test patterns
12. Pixel sizing (x, y gain setting)

I. Radiopharmacy/hot lab computers
   1. Hot lab and patient management
   2. Health physics
   3. Pharmacy management
Instrumentation: Imaging

This section deals with in-depth information on the components, use, and quality control of the various types of systems used for gamma, positron, and X-ray imaging. The learning experience should include laboratory and clinical experience.

Objectives:

1. Describe and apply the principles and operation of Anger scintillation cameras
2. Describe and apply the principles and operation of multicrystal scintillation cameras
3. Describe and apply the principles and operation of solid state detector systems
4. Describe and apply the principles and operation of SPECT and SPECT/computed tomography (CT)
5. Describe and apply the principles and operation of positron emission tomography (PET)/CT
6. Describe and apply the principles and operation of CT
7. Demonstrate operation of imaging equipment
8. Perform quality control procedures and analyze the results
Instrumentation: Imaging

I. Anger Scintillation Cameras
   A. Principles and system configurations
      1. Collimator
         a. Geometric characteristics
            i. Resolution
            ii. Efficiency
         b. Selection considerations
      2. Crystal
         a. Types
         b. Resolution
         c. Efficiency
      3. Photomultiplier tubes
         a. Cathode
         b. Dynode
         c. Anode
         d. Electron multiplication
      4. Light pipe
      5. Analog-to-digital converters
      6. Preamplifier/amplifier
      7. Positioning circuitry
      8. Ratio circuits
      9. Summation circuitry
     10. Pulse-height analyzer
         a. Window width
         b. Centerline versus nonsymmetrical window
         c. Z-pulse
     11. Scalers and rate meters
     12. Digital-to-analog converters
     13. Imaging
         a. Static
            i. Length
            ii. Time/counts per frame
            iii. Matrix size
            iv. Collimation
            v. Spatial resolution
         b. Whole body acquisition
            i. Body contouring
            ii. Information density
            iii. Scan speed
            iv. Matrix size
         c. Dynamic
            i. Length
            ii. Time per frame
iii. Matrix size
iv. Collimation
v. Temporal resolution
d. Gated
e. SPECT

14. Image display
a. Static
b. Cine
c. 3-dimensional/volumetric

15. Data recording
a. Disk
b. Film
c. Printer
d. Other

16. Mobile camera systems

B. Performance characteristics

1. Collimators
a. Types
b. Parallel-hole
   i. Low energy all purpose or general all purpose
   ii. High resolution versus high sensitivity
   iii. Ultrahigh resolution
   iv. Medium energy
   v. High energy
   vi. High sensitivity
c. Diverging/converging
d. Pinhole
e. Slant-hole
f. Fan-beam

2. Characteristics
a. Spatial resolution
b. Sensitivity
c. Field of view
d. Image size (magnification/minification)
e. Image distortion
f. Energy characteristics

3. Camera
a. Spatial resolution
   i. Full width half maximum
   ii. Modulation transfer function
b. Sensitivity
c. Linearity
d. Uniformity
   i. Specifications (differential/integral)
   ii. Factors affecting uniformity
iii. Uniformity versus intrinsic resolution
   e. Energy resolution
   f. Dead time
   g. Count rate
   h. Image contrast

II. Multicrystal Scintillation Cameras
   A. Principles of operation
   B. Performance characteristics
      1. Spatial resolution
      2. Sensitivity
      3. Uniformity
      4. Energy
      5. Count rate

III. Solid State Detector Systems
   A. Principles of operation
   B. Performance characteristics
      1. Spatial resolution
      2. Sensitivity
      3. Uniformity
      4. Energy
      5. Count rate

IV. SPECT and SPECT/CT
   A. Basic designs and principles
      1. Orbit design
         a. Circular
         b. Body contour
         c. Elliptical
      2. Collimator design
      3. Multihead systems
         a. Fixed
            i. 180 degrees with 2 detectors
            ii. 90 degrees with 2 detectors
         b. Variable
      4. Attenuation correction
         a. Attenuation filters
         b. Sealed/rod source
         c. X-ray
      5. Acquisition parameters
         a. Matrix size and linear sampling
         b. Degrees of rotation
         c. Number of projections (angular sampling)
         d. Time per projection
         e. Time per acquisition
f. Image density versus image contrast

6. Factors that limit statistics
   a. Radiopharmaceutical dose limits
   b. Time restraints
   c. Source-to-detector distance
   d. Attenuation

7. Reconstruction: analytical and iterative
   a. Filtered (convoluted) back-projection
      i. Collection of planar images (2-dimensional format)
      ii. Sum of the images
      iii. Pixels and voxels
   b. Fourier
      i. Spatial and frequency domain
      ii. Elimination of the star defect
   c. Iterative reconstruction
      i. Maximum likelihood expectation maximization
      ii. Ordered subsets expectation maximization
      iii. Other
   d. Reconstruction parameters
      i. Center of rotation correction
      ii. Uniformity correction
      iii. Attenuation correction
      iv. Filters and filter selection
      v. Attenuation correction with external transmission sources
      vi. Motion correction and linograms/sinograms

V. PET Systems
   A. Basic principles of operation
   B. Sensitivity/dead time
   C. Spatial resolution
   D. System configurations
   E. Time of flight
   F. Coincidence detection
   G. Projection of data collection
   H. Crystal characteristics
   I. Limits of resolution
      1. Range of the positron
      2. Angulation
      3. Detector size
         a. Size of the ring diameter
         b. Size of the detector elements
      4. Detector design
         a. Block detector
b. Detector cassettes
c. Ring architecture

J. Signal-to-noise ratio
   1. True coincident event
   2. Compton scatter
   3. Random event

K. Imaging
   1. 2-dimensional
   2. 3-dimensional

L. Absolute calibration (standard uptake value)

M. Attenuation and correction methods
   1. Transmission
      a. Orbiting rod sources
      b. CT
         i. Image segmentation
   2. Coregistration

N. Iterative reconstruction
   1. Maximum likelihood expectation maximization
   2. Ordered subsets expectation maximization
   3. Other

VI. CT Systems
A. Basic principles of operation
   1. History and development
   2. CT X-ray tube design
      a. Voltage variation
      b. X-ray filter
   3. CT scanner design
      a. Detectors
      b. Collimation
      c. Rotational speed

B. Multislice helical CT

C. Image data acquisition

D. Image reconstruction

E. Image display

F. Display of volumetric data

G. Image quality
   1. Contrast resolution
   2. Image noise

H. CT protocols
   1. Low-dose CT for PET attenuation correction
   2. Diagnostic CT

I. CT acquisitions
   1. Neck CT
   2. Chest CT
   3. Abdomen CT
a. Pelvis CT
b. Extremity CT
4. CT contrast media
5. Types
6. Administration
J. Integrated PET/CT protocols
K. CT artifacts
   1. Operation
   2. Scanner
   3. Patient
L. CT radiation safety
   1. Room construction
   2. Personnel safety
   3. Patient dose

VII. Quality Control of Imaging Systems
A. Anger scintillation camera
   1. Flood uniformity
   2. Positioning circuitry
   3. Spatial resolution
   4. Linearity
   5. Sensitivity
   6. Pixel sizing
   7. Energy resolution
   8. Energy calibration
   9. Environmental control
   10. Intrinsic versus extrinsic measurements
   11. Collimator
      a. Septal penetration
      b. Damage detection

B. SPECT systems
   1. Center of rotation
   2. Cylindrical phantoms
   3. High count flood uniformity

C. PET imaging systems
   1. Characterization
   2. Correction calibrations

D. CT (on a PET/CT or SPECT/CT system)
   1. Scanner
   2. Image
   3. Dose
Chapter 12

Nuclear Pharmacy and Pharmacology
Nuclear Pharmacy and Pharmacology

This section covers the theory and practice of radiopharmacy, including preparation and calculation of the dose to be administered, quality control, radiation safety, and applicable regulations. In addition, it deals with nonradioactive interventional drugs and contrast media that are used as part of nuclear medicine procedures. For all administered materials, it addresses the routes of administration, biodistribution mechanisms, interfering agents, contraindications, and adverse effects. Students need to have experience in laboratories, the clinical setting, or a centralized radiopharmacy in order to become proficient in this area.

Objectives:

1. Explain the basic concepts of radionuclides and radiopharmaceuticals
2. Identify and list the characteristics of the ideal radiopharmaceutical
3. Describe the Food and Drug Administration and US Pharmacopeia control of pharmaceuticals and radiopharmaceuticals
4. Describe the basic concepts of radiochemistry
5. Describe generator kinetics in the production of radionuclides
6. Demonstrate appropriate generator elution techniques
7. Describe quality control procedures, including radionuclide purity, radiochemical purity, and chemical impurities
8. Demonstrate proper compounding of radionuclide-labeled kits
9. Discuss the production and characteristics of positron emitters and positron-labeled radiopharmaceuticals
10. Prepare and store radioactive volatiles and gases in accordance with federal regulations
11. Determine and calculate appropriate patient doses
12. Explain the normal and altered biodistribution properties of radiopharmaceuticals
13. Describe the characteristics, proper use, and pharmacokinetics of radiopharmaceuticals, pharmaceuticals, and contrast media
14. Analyze patient information to determine adverse reactions, interfering drugs, and contraindications for administration of radiopharmaceuticals, pharmaceuticals, and contrast media
Nuclear Pharmacy and Pharmacology

I. Introduction
   A. Definitions
      1. Nuclide versus isotope
      2. Radionuclide and radioactivity
      3. Radioactive drug (legal definition)
      4. Units of radioactivity
      5. Specific activity
      6. Specific concentration
      7. Carrier content
      8. Half-life
   B. Basic characteristics of a radiopharmaceutical
      1. Radioactive component
      2. Pharmaceutical component
   C. Desirable characteristics for a radionuclide
      1. Limiting agents
         a. Patient’s radiation dose
         b. “As Low As Reasonably Achievable” (ALARA)
         c. Sufficient photon flux and activity for imaging
         d. Speed of uptake and imaging times
         e. Instrument limitations
         f. Diagnostic versus therapeutic requirements
      2. Ideal characteristics for diagnostic nuclide
         a. Type of radiation
         b. Energy
         c. Monoenergetic versus multiple energies
         d. Half-life
      3. Ideal characteristics for a therapeutic nuclide
         a. Type of radiation
         b. Energy
         c. Half-life
      4. Desirable characteristics for a radiopharmaceutical
         a. Noninvasive, nonpharmacologic
         b. Clearance time
            i. Plasma clearance
            ii. Target uptake
            iii. Target clearance
            iv. Biological half-life
         c. Target-to-background ratio
         d. Ease of preparation
         e. Shelf life
   5. Routes of administration
      a. Oral
      b. Intravenous injection
      c. Inhalation
d. Intrathecal injection
e. Intracavitary injection
f. Subcutaneous injection
g. Urethral infusion

II. Radiation Protection and Regulations in Reference to Radiopharmacy

III. Food and Drug Administration and US Pharmacopeia Control of Pharmaceuticals
A. Scope of control
B. Research requirements
   1. Basic research
   2. Investigational New Drug
   3. New Drug Application and approval
C. Regulations for use of Investigational New Drug or New Drug Application in nuclear medicine facility

IV. Radiochemistry
A. Definitions
   1. Types of aqueous solutions
   2. Chemical species
B. Reactivity
   1. Valence state
   2. Free radicals
   3. Oxidation numbers
   4. Oxidation/reduction reactions
C. Chemical bonds
D. Technetium chemistry
   1. Terminology and chemical formulas
   2. Oxidation states
      a. Desirable states
      b. Reducing agents
      c. Reoxidation
   3. Radiolabeling with Tc-99m
      a. Types of compounds
      b. Types of bonds
   4. Undesirable technetium complexes
   5. Free pertechnetate
   6. Hydrolyzed-reduced technetium
      a. Radiolabeling with long-lived radionuclides
      b. Tagging blood components
         i. Anticoagulants
         ii. Blood withdrawal/reinjection techniques
         iii. Sources of error

V. Radionuclide Generators
A. Principles
   1. Parent/daughter relationship
   2. Equilibrium
   3. Transient versus secular equilibrium
   4. Effects of elution
B. Mo99/Tc99m generators
   1. Components and configuration
   2. Changes in activity with time and elution
   3. Elution efficiency
   4. Yield calculation
   5. Elution technique
   6. Wet versus dry
   7. Causes of fluctuation in yield
      a. Molybdenum loading inconsistencies
      b. Channeling
      c. Radiolysis
      d. Mechanical problems
C. Sr82/Rb82 generators
   1. Configuration
   2. Changes in activity with time and elution
   3. Useful life span

VI. Quality Control
A. Radionuclidic purity
   1. Definition
   2. Basic calculation
   3. Effects of impurities
   4. Sources
   5. Test methods
      a. Shield method
      b. Spectrometry
   6. Limits
      a. Mo99 in Tc99m
      b. Other nuclides
   7. Effect of decay
B. Radiochemical purity
   1. Definition
   2. Basic calculation
   3. Effects of impurities
   4. Causes of impurities
      a. Radiolysis
      b. Time
   5. Sources
   6. Test methods
      a. Radiochromatography
      b. Solid-phase extraction (eg, Sep-Pak®)
7. Limits
C. Chemical impurity
   1. Definition
   2. Alumina in Tc99m generator eluate
      a. Test method
      b. Limits
      c. Interpretation
      d. Significance
   3. Impurities in other radiopharmaceuticals
D. Ph
   1. Definition
   2. Test method
   3. Limits
   4. Interpretation
   5. Significance
E. Particle size
   1. Test method
   2. Limits
   3. Interpretation
   4. Significance
F. Visual appearance
   1. Color
   2. Clarity
G. Sterility
   1. Definition
   2. Effects of contaminants
   3. Sources of contaminants
   4. Sterilization methods
   5. Test methods
   6. Maintenance of sterility
H. Apyrogenicity
   1. Definition
   2. Effects of contaminants
   3. Sources of contaminants
   4. Test methods
      a. Rabbit test
      b. Bacterial endotoxin test
      c. Comparison

VII. Tc99m-Labeled Kit Preparation
A. Kit components
   1. Ligand
   2. Reducing agent
   3. Antioxidant
   4. pH buffer
   5. Atmosphere
B. Kit production
   1. Sterilization
   2. Lyophilization
C. Kit Preparation
   1. Compounding technique
   2. Diluent
   3. Factors to be considered
      a. Volume limits
      b. Activity limits
      c. Postreconstitution shelf life
      d. Storage requirements
D. Record keeping

VIII. Preparation of Positron Emitters
A. Production
   1. Generator systems
   2. Cyclotron systems
B. Characteristics of positron emitters
   1. Physical
   2. Chemical
C. Biochemical characteristics
   1. $^{11}$C
   2. $^{15}$O
   3. $^{13}$N
   4. $^{18}$F
   5. Other
D. Synthesis of radiopharmaceuticals
E. Quality control of radiopharmaceuticals

IX. Radioactive volatiles and gases
A. Storage requirements
B. Room concentration limits
C. Calculation of room clearance time
D. Negative pressure requirements
E. Postings
F. Special considerations for radioiodine

X. Dose Determination
A. Dose range
   1. Factors affecting dose determination
   2. Organ or system size
   3. Photon flux
   4. Radiation dose
B. Nuclear Regulatory Commission acceptable ranges
C. Nuclear Regulatory Commission calibration requirements
XI. Calculation of Patient Dose
   A. Specific concentration
   B. Volume to be administered
   C. Dilution of doses
   D. Unit dose adjustment
   E. Consideration for decay
      1. Decay calculation
      2. Decay factor tables
      3. Universal decay table
   F. Calculation of pediatric doses
      1. Factors affecting pediatric dose administration
         a. Minimum and maximum
         b. Body surface area
         c. Administration per unit weight
      2. Other

XII. Biodistribution
   A. Clearance and uptake times
      1. Plasma clearance
      2. Organ/tissue uptake and retention
      3. Organ clearance and redistribution
      4. Excretion routes
      5. Biological half-life
   B. Common mechanisms of localization
      1. First transit
      2. Simple exchange diffusion
      3. Active transport
      4. Capillary blockage
      5. Compartment localization
      6. Electrostatic binding
      7. Phagocytosis
      8. Antibody and antibody fragment localization
      9. Receptor localization
      10. Cellular sequestration
      11. Metabolism
      12. Other

XIII. Individual Radiopharmaceuticals
   A. For each radiopharmaceutical on the Nuclear Medicine Technology Certification Board Pharmacy List, the following elements will be examined:
      1. Clearance and uptake
      2. Method of localization
      3. Alternate names
      4. Indications for use
      5. Dose range
6. Route of administration  
7. Specific chemical and physical properties  
8. Method of preparation  
9. Biodistribution mechanisms, including initial uptake, redistribution, and excretion  
10. Critical organ doses, gonadal dose, whole body dose  
11. Target organ  
12. Quality control consideration and limit  
13. Interfering agents and their effects  
14. Adverse reactions  
   a. Vasovagal reaction  
   b. Pyrogenic  
   c. Allergic  
   d. Anaphylactic  
   e. Reporting mechanism  

XIV. Pharmaceuticals  
A. Administration by Nuclear Medicine Technologists  
   1. Regulations  
   2. Ethical implications  
   3. Training  
   4. Procedural considerations  
B. Interventional agents  
   1. Class of drug  
   2. Alternate names  
   3. Indications  
   4. Mechanism of action  
   5. Pharmacokinetics  
   6. Dosage range  
   7. Precautions and contraindications  
      a. Other drugs  
      b. Pathologic conditions  
C. Adverse reactions  
   1. Vasovagal reaction  
   2. Allergic  
   3. Anaphylactic  
   4. Reporting mechanism  
D. Common interventional drugs used in nuclear medicine  
   1. Dipyridamole  
   2. Adenosine  
   3. Dobutamine  
   4. Aminophylline  
   5. Captopril  
   6. Enalaprilat  
   7. Furosemide  
   8. Insulin
9. Acetazolamide  
10. Cholecystokinin/sinclalide/CCK  
11. Morphine  
12. Cimetidine/ranitidine/famotidine  
13. Glucagon  
14. Pentagastrin  
15. ACD solution  
16. Heparin  
17. Ascorbic acid  
18. Hetastarch  
19. Lugol's solution/SSKI  
20. Thyroid-stimulating hormone  
21. Ethylenediaminetetraacetic acid  
22. Lidocaine  
23. Lidocaine (EMLA) cream  
24. Atropine  
25. Recombinant human thyroid-stimulating hormone  
26. Nitroglycerin  
27. Acetaminophen  
28. Diphenhydramine hydrochloride  
29. Aspirin  
30. Other

XV. Contrast Media  
A. Class of drug  
B. Alternate names  
C. Indications  
D. Mechanism of action  
E. Pharmacokinetics  
F. Dosage range  
G. Precautions and contraindications  
1. Other drugs  
2. Pathologic conditions  
H. Adverse reactions  
1. Vasovagal reaction  
2. Allergic  
3. Anaphylactic  
4. Reporting mechanism  
I. Calculation of patient dose  
1. Specific concentration  
2. Volume to be administered  
3. Dilution of doses  
4. Unit dose  
J. Calculation of pediatric doses  
1. Factors affecting pediatric dose administration  
   a. Minimum and maximum
b. Body surface area
   c. Administration per unit weight

2. Other

K. Intravenous

1. High-osmolality ionic agents
   a. Sodium/meglumine diatrizoate
   b. Sodium/meglumine metrizoate

2. Low-osmolality nonionic
   a. Iopamidol
   b. Iopromide
   c. Iohexol

3. Low-osmolality ionic agents
   a. Sodium/meglumine ioxaglate
   b. Other
   c. Oral

4. Barium sulfate

5. Sodium amidotrizoate

6. Meglumine amidotrizoate

7. Other
   a. Air
Chapter 13

Diagnostic Procedures
Diagnostic Procedures

This section covers diagnostic procedures, including anatomy and physiology, pathophysiology, and protocols for routine and non-routine nuclear medicine procedures. Some of the procedures addressed may not be assessed by credentialing agencies but are included as essential to the theory and understanding of nuclear medicine. Clinical experience must be acquired to enhance the didactic learning of all commonly performed diagnostic procedures.

Objectives:

1. Review anatomy and physiology for each organ system
2. Describe the pathology and pathophysiology associated with each organ system
3. Recognize and explain clinical indications for diagnostic procedures
4. Describe and apply the appropriate diagnostic protocols
5. Evaluate images and quantitative data for technical quality, including artifacts and normal variants
Diagnostic Procedures: Skeletal

I. Anatomy and Physiology
   A. Matrix structure and composition
   B. Bone growth
   C. Bone repair
   D. Hormonal control of blood/bone calcium

II. Pathology: For each of the following disease states, these topics will be covered: characteristics, causes, population, and treatment
   A. Malignant diseases
   B. Benign neoplasms
   C. Inflammatory diseases
   D. Skeletal fractures
   E. Skeletal pain
   F. Bone viability
   G. Bone density
   H. Vascular abnormalities

III. Whole-Body Bone Scan
   A. Indications
   B. Radiopharmaceuticals
      1. Tracer
         a. Tc-99m methylene diphosphonate (MDP)
         b. Tc-99m hydroxymethylene diphosphonate (HDP)
      2. Route of administration
      3. Biodistribution
         a. Distribution
         b. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interpretation of images and data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

IV. Multiphase Bone Imaging
   A. Indications
   B. Radiopharmaceuticals
      1. Tracer
         a. Tc-99m MDP
         b. Tc-99m HDP
      2. Route of administration
      3. Biodistribution
         a. Distribution
         b. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. 6- to 24-hour delay (fourth phase)
      5. Data processing
      6. Image display/format
      7. Sources of error
   G. Interpretation of images and data
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
         a. Imaging
b. Nonimaging

V. Single-Photon Emission Computed Tomography (SPECT) and SPECT/Computed Tomography (CT) Bone Scan
A. Indications
B. Radiopharmaceuticals
   1. Tracer
      a. Tc-99m MDP
      b. Tc-99m HDP
   2. Route of administration
   3. Biodistribution
      a. Distribution
      b. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VI. Positron Emission Tomography (PET) and PET/CT
A. Indications
B. Radiopharmaceuticals
   1. Tracer
      a. F-18
   2. Route of administration
3. Biodistribution
   a. Distribution
   b. Excretion
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
   1. Emission
   2. Transmission
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VII. Bone Density/Absorptiometry
    A. Indications
    B. Radionuclide method
    C. Radiographic method
Diagnostic Procedures: Cardiovascular

I. Review of Anatomy and Physiology
   A. Gross anatomy and function
      1. Heart chambers
      2. Tissue layers
         a. Endocardium
         b. Myocardium
      3. Epicardium
      4. Pericardium
   B. Cellular physiology
   C. Blood flow
      1. Coronary
      2. Systemic
   D. Conduction system and pathways
   E. Cardiac cycle
   F. Functional parameters
      1. Ejection fraction
      2. Stroke volume
      3. Cardiac output
      4. Other

II. Pathology: For each of the following disease states, these topics will be covered: characteristics, causes, population, and treatment
   A. Spectrum of coronary artery disease
   B. The heart and great vessels
      1. Coronary artery disease
         a. Ischemia
         b. Infarction
         c. Hibernating or stunned myocardium
         d. Zones of ischemia, injury, and infarction
         e. Coronary artery spasm
         f. Angina
         g. Congestive heart failure
      2. Congenital abnormalities
         a. Transposition of the great vessels
         b. Dextrocardia
         c. Situs inversus
         d. Septal defects
      3. Valve disease
         a. Mitral valve prolapse/stenosis/regurgitation
         b. Tricuspid stenosis/regurgitation
      4. Infectious disease
      5. Pericardial effusion
      6. Cardiomyopathy
      7. Chemotherapeutic toxicity
8. Arrhythmias
9. Transplant rejection
10. Thyroid-related heart disease
11. Cardiac tumors
12. Coarctation of aorta

C. Systemic vasculature
   1. Arteriosclerosis
   2. Aneurysms
   3. Phlebitis
   4. Deep vein thrombosis
   5. Hypertension

III. Cardiac Stress Testing Methods
A. Indications
B. Contraindications and adverse reactions
   1. Physical or pathologic conditions
   2. Possible interfering drugs
   3. Precautions
   4. Adverse reactions
C. Patient preparation (including consent if applicable)
D. Equipment
   1. Treadmill
   2. Supine cycle
   3. Upright cycle
   4. Hand ergometer
   5. Electrocardiogram (ECG) monitor
   6. Blood pressure monitor
   7. Infusion pump
E. Basic procedure
   1. Protocols
   2. ECG
      a. Skin preparation
      b. Electrode placement
   3. End points
F. Interventional procedures
   1. Pharmacologic intervention
      a. Pharmaceuticals and mechanisms of action
         i. Dipyridamole
         ii. Adenosine
         iii. Dobutamine/arbutamine/atropine
         iv. A2A agents
      b. Indications/contraindications and adverse effects
      c. Antidotes for the reversal of the adverse effects
      d. Administration protocols
      e. Patient preparation
      f. Infusion pump
CURRICULUM GUIDE

g. Pharmacologic intervention with low-level physical exercise
   i. Indications/contraindications and adverse effects
   ii. Positive effects of introducing low-level physical exercise

h. Administration protocols

G. Cardiac electrophysiology
   1. Leads
      a. 3-lead
      b. 12-lead
   2. ECG interpretations
      a. ECG strip measurements
      b. Patterns
         i. Normal rhythm
         ii. Segment changes
         iii. Basic arrhythmias
         iv. Other ECG abnormalities

IV. Myocardial Perfusion/Viability
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Thallium-201
         b. Technetium-99m sestamibi
         c. Technetium-99m tetrofosmin
         d. Fluorine-18 fluorodeoxyglucose
         e. Nitrogen-13 ammonia
         f. Rb-82 chloride
         g. Dual nuclide: Thallium-201 and a Tc-99m agent
         h. O-15 water
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
         d. Extraction fraction
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Equipment
1. Imaging equipment
2. Ancillary equipment
   a. Immobilization devices
   b. Comfort devices
   c. Rb-82 infusion cart
   d. Gating devices

F. Protocol
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Data processing
   a. Cineangiograms
   b. Ejection fraction determination
   c. Functional images
   d. Heart-lung ratios
   e. Image manipulation techniques
   f. Image filtering
   g. Polar plot analysis
   h. Wall motion analysis
   i. Attenuation correction
   j. Time-activity curves
   k. Summed stress score, summed rest score, summed difference score
   l. Quantitative software techniques
5. Image display/format
   a. Short axis
   b. Vertical long axis
   c. Horizontal long axis

G. Artifacts
1. Radiopharmaceutical distribution and attenuation factors
2. Acquisition parameters
   a. Uniformity
   b. Energy window
   c. Gating
   d. Motion
   e. COR
   f. Attenuation
3. Processing parameters

H. Interpretation of images and data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
V. Equilibrium Radionuclide Angiocardiography, Also Known as Multigated Blood Pool Acquisition, Gated Blood Pool Scan, or Radionuclide Ventriculography

A. Indications

B. Radiopharmaceuticals
1. Tc-99m tagged red blood cells (RBCs)
   a. In vivo
   b. In vitro
   c. Modified in vivo/in vitro
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry

C. Contraindications and adverse reactions
1. Physical or pathologic conditions
2. Interfering studies
3. Possible interfering drugs
4. Precautions
5. Adverse reactions

D. Patient preparation

E. Equipment
1. Imaging equipment
2. Ancillary equipment
   a. Cardiac monitor for gating
   b. Supine bicycle for exercise if applicable
   c. Infusion pump if applicable
   d. Blood pressure monitor
   e. ECG monitor

F. Protocol
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Data processing
   a. Ejection fraction calculations
   b. Cine display
   c. Other measurements
5. Image display/format
6. Sources of error

G. Interventional procedures
1. Supine bicycle exercise
2. Dobutamine
H. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VI. First-Pass Radionuclide Angiography
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m DTPA (penetrate)
      b. Tc-99m pertechnetate
      c. Any Tc-99m labeled radiopharmaceutical of at least 15 mCi (except macroaggregated albumin [MAA])
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical or pathologic conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Equipment
   1. Imaging
   2. Upright bicycle or treadmill if applicable
   3. Gating devices
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
      a. Ejection fraction calculations
      b. Functional images
      c. Cine display
      d. Left-to-right shunt quantification
      e. Other measurements
VII. Infarct Imaging
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m pyrophosphate
         b. In-111 antimyosin
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Precautions
      4. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VIII. Major Vessel Flow Study (eg, Superior Vena Cava Obstruction Study)
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m DTPA (pentetate)
         b. Tc-99m pertechnetate
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Precautions
      4. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Image display/format
      5. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
         a. Imaging
         b. Nonimaging

IX. Venogram/Thrombus Localization
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m MAA
         b. Other
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Image display/format
   5. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Central Nervous System

I. Review of Anatomy and Physiology
   A. Gross anatomy
   B. Cellular anatomy
   C. Blood-brain barrier
   D. Cerebrospinal fluid (CSF) production and flow

II. Pathology
   A. Dementia
   B. Epilepsy
   C. Stroke
   D. Transient ischemic attack
   E. Trauma
   F. Movement disorders
   G. Psychiatric disorders
   H. Brain death
   I. Tumor imaging
   J. CSF disorders/leaks/patency

III. Cerebral Vascular Flow
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m sodium pertechnetate
         b. Tc-99m DTPA
         c. Tc-99m GH
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      a. Physical conditions
      b. Interfering studies
      c. Possible interfering drugs
      d. Precautions
      e. Adverse reactions
   D. Patient preparation
   E. Protocol
      1. Acquisition parameters
      2. Dose range and administration technique
      3. Positioning and views
      4. Data processing
      5. Image display/format
6. Sources of error

F. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

IV. Planar Brain Imaging
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m sodium pertechnetate
         b. Tc-99m DTPA
         c. Tc-99m GH
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Image display/format
      5. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

V. Functional Brain SPECT
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m HMPAO
         b. Tc-99m ECD
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interventional protocols
      1. Vasodilators (acetazolamide)
      2. Psychological stress studies
      3. Sensory stimulation studies
   H. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
         a. Imaging
         b. Nonimaging
VI. PET and PET/CT Imaging of the Brain
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Fluorine-18 fluorodeoxyglucose
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reaction
D. Patient preparation
E. Equipment
   1. Imaging
      a. Emission
      b. Transmission
   2. Accessory
      a. Head immobilizer
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interventional protocols
   1. Vasodilators (acetazolamide)
   2. Psychological stress studies
   3. Sensory stimulation studies
H. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
VII. Brain Tumor Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Thallium-201
      b. Tc99m sestamibi
      c. Fluorine-18 fluorodeoxyglucose
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VIII. CSF Studies
A. Cisternography
   1. Indications
   2. Radiopharmaceuticals
      a. Tracers
         i. Ytterbium-169 DTPA
         ii. Indium-111 DTPA
iii. Tc-99m DTPA for pediatrics

b. Route of administration
c. Biodistribution
   i. Uptake
   ii. Distribution
   iii. Excretion
d. Dosimetry

3. Contraindications and adverse reactions
   a. Physical conditions
   b. Interfering studies
   c. Possible interfering drugs
d. Precautions
e. Adverse reactions

4. Patient preparation

5. Imaging equipment

6. Protocol
   a. Dose range and administration technique
   b. Acquisition parameters
c. Positioning and views
d. Data processing
e. Image display/format
f. Sources of error

7. Interpretation of images
   a. Normal
   b. Normal variants
   c. Abnormal
d. Artifacts
e. Diagnostic/prognostic value of the study
f. Evaluation of technical quality
g. Correlative tests
   i. Imaging
   ii. Nonimaging

IX. CSF Leak Study
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Indium-111 DTPA
      2. Biodistribution
         a. Uptake
         b. Distribution
c. Excretion
   3. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
3. Possible interfering drugs
4. Precautions
5. Adverse reactions
D. Patient preparation
E. Equipment
1. Imaging
2. Ancillary
   a. Pledgets
   b. Well counter
   c. Laboratory equipment for plasma sample counting
F. Protocol
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Data processing
5. Image display/format
6. Sources of error
G. Interpretation of images
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Other
X. CSF Shunt Patency (Ventriculoperitoneal or Ventriculoatrial Shunt Study)
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m DTPA
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Patient preparation
D. Contraindications and adverse reactions
   1. Physical condition
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
5. Adverse reactions

E. Patient preparation

F. Imaging equipment

G. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error

H. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Other
Diagnostic Procedures: Digestive System

I. Review of Anatomy and Physiology
   A. Gross anatomy and function
   B. Cellular anatomy and function
   C. Blood flow
   D. Bile production and flow

II. Pathology: For each of the following disease states, these topics will be covered: characteristics, causes, population, and treatment
   A. Primary and metastatic neoplasms
   B. Salivary gland disorders
      1. Sjögren’s disease
      2. Warthin’s tumor
      3. Obstruction
      4. Space-occupying lesions
   C. Disorders of the esophagus
      1. Gastroesophageal reflux disease
      2. Esophagitis
      3. Achalasia
      4. Scleroderma
      5. Barrett’s esophagus
   D. Gastric disorders
   E. Liver and gallbladder
   F. Splenic disease
   G. Gastrointestinal bleeding
   H. Meckel’s diverticulum

III. Salivary Gland Imaging
   A. Indications
   B. Radiopharmaceutical
      1. Tracers
         a. Tc-99m pertechnetate
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
   7. Interventional procedures
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

IV. Esophageal Motility/Transit and Reflux
A. Indications
B. Radiopharmaceutical
   1. Tracers
      a. Tc-99m sulfur colloid
   2. Route of administration
   3. Biodistribution
      a. Distribution
      b. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
      a. Motility and transit
      b. Reflux
      c. Pulmonary aspiration
   4. Data processing
5. Image display/format
6. Sources of error

G. Interventional procedures

H. Interpretation of images and data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

V. Gastric Emptying
A. Indications

B. Radiopharmaceuticals
1. Tracer
   a. Tc-99m sulfur colloid (solid or liquid)
   b. In-111 DTPA (liquid)
2. Meal composition
3. Route of administration
4. Biodistribution
   a. Distribution
   b. Excretion
5. Dosimetry

C. Contraindications and adverse reactions
1. Physical and pathologic conditions
2. Interfering studies
3. Possible interfering drugs
4. Precautions
5. Adverse reactions

D. Special radiation safety conditions

E. Patient preparation

F. Imaging equipment

G. Protocol
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Data processing
5. Image display/format
6. Sources of error

H. Interpretation of images and data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VI. *Helicobacter pylori* Detection
A. Indications
B. Radiopharmaceutical
   1. Tracers
      a. Carbon-14–labeled urea
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Special radiation safety conditions
D. Patient preparation
E. Equipment
   1. Collecting device
   2. Liquid scintillation counter
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Sources of error
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Sources of error
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VII. Liver/Spleen
A. Indications
B. Radiopharmaceutical
   1. Tracers
      a. Tc-99m sulfur colloid
   2. Route of administration
   3. Biodistribution
      a. Uptake
b. Distribution  
c. Excretion  
4. Dosimetry  
C. Contraindications and adverse reactions  
1. Physical and pathologic conditions  
2. Interfering studies  
3. Precautions  
4. Adverse reactions  
D. Patient preparation  
E. Imaging equipment  
F. Protocol  
1. Dose range and administration technique  
2. Acquisition parameters  
3. Positioning and views  
4. Data processing  
5. Image display/format  
6. Sources of error  
G. Interpretation of images and data  
1. Normal  
2. Normal variants  
3. Abnormal  
4. Artifacts  
5. Diagnostic/prognostic value of the study  
6. Evaluation of technical quality  
7. Correlative tests  
   a. Imaging  
   b. Nonimaging  

VIII. Splenic Imaging With Heat-Denatured RBCs  
A. Indications  
B. Radiopharmaceuticals  
1. Tracers  
   a. Tc-labeled denatured RBCs  
2. Dose range and route of administration  
3. Biodistribution  
   a. Uptake  
   b. Distribution  
   c. Excretion  
4. Dosimetry  
C. Contraindications and adverse reactions  
1. Physical conditions  
2. Interfering studies  
3. Possible interfering drugs  
4. Precautions  
5. Adverse reactions  
D. Patient preparation
E. Imaging equipment
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
IX. Hemangioma Detection
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m–labeled RBCs
         b. Tc-99m sulfur colloid
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
G. Interpretation of images and data
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

X. Hepatobiliary Imaging
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m iminodiacetic acid derivatives
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interventional procedures
      1. Morphine augmented
      2. Cholecystokinin pretreatment and intervention
      3. Phenobarbital
   H. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

XI. Gastrointestinal Bleed
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m sulfur colloid
      b. Tc-99m–labeled RBCs
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

XII. Meckel’s Diverticulum
A. Indications
B. Radiopharmaceutical
   1. Tracers
      a. Tc-99m pertechnetate
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Image display/format
   5. Sources of error
G. Interventional procedures
   1. Glucagon
   2. Cimetidine
   3. Pentagastrin
H. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

XIII. LeVeen Shunt
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m MAA
      b. Tc-99m sulfur colloid
   2. Route of administration
   3. Biodistribution
CURRICULUM GUIDE

a. Uptake
b. Distribution
c. Excretion
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Special radiation safety conditions
E. Patient preparation
F. Imaging equipment
G. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Image display/format
   5. Sources of error
H. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

XIV. Intrahepatic Pump Study
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m MAA
      b. Tc-99m sulfur colloid
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Image display/format
   5. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Endocrine/Exocrine System

I. Review of Anatomy and Physiology
   A. Gross anatomy and function
      1. Thyroid
      2. Parathyroids
      3. Adrenals
      4. Lacrimal glands
   B. Cellular anatomy and function
   C. Thyroid hormone production and function
   D. Hypothalamus-pituitary-thyroid feedback system
   E. Other feedback systems

II. Pathology: For each of the following disease states, these topics will be covered: characteristics, causes, population, and treatment
   A. Thyroid
      1. Benign diseases
         a. Hyperthyroidism
         b. Hypothyroidism
      2. Malignancy
   B. Parathyroid
      1. Hyperparathyroidism
      2. Hypoparathyroidism
   C. Adrenal
      1. Addison’s disease and other hypofunctional diseases
      2. Cushing’s disease and other hyperfunctional diseases
      3. Pheochromocytoma
      4. Neuroblastoma
   D. Lacrimal duct obstruction

III. Thyroid Uptake Study
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. I-123 sodium iodide
         b. I-131 sodium iodide
         c. Tc-99m sodium pertechnetate
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
3. Possible interfering drugs
4. Precautions
5. Adverse reactions

D. Patient preparation

E. Equipment
1. Uptake probe
2. Neck phantom
3. Gamma camera

F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning
4. Data processing
5. Sources of error

G. Interpretation of data
1. Normal
2. Abnormal
3. Diagnostic/prognostic value of the study
4. Evaluation of technical quality
5. Correlative tests
   a. Imaging
   b. Nonimaging

IV. Thyroid Scan

A. Indications

B. Radiopharmaceuticals
1. Tracers
   a. I-123 sodium iodide
   b. I-131 sodium iodide
   c. Tc-99m sodium pertechnetate
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry

C. Contraindications and adverse reactions
1. Physical conditions
2. Interfering studies
3. Possible interfering drugs
4. Precautions
5. Adverse reactions

D. Patient preparation

E. Imaging equipment

F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Image display/format
5. Sources of error

G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

V. Parathyroid Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m sestamibi
      b. Tc-99m sestamibi/I-123 sodium iodide
      c. Tc-99m sestamibi/Tl-201 thallous chloride
      d. Tc-99m sodium pertechnetate/Tl-201 thallous chloride
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images and data
   1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VI. Adrenal Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. I-123 metaiodobenzylguanidine
      b. I-131 metaiodobenzylguanidine
      c. I-131 norcholesterol
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
b. Nonimaging

VII. Lacrimal Duct Imaging (Dacryoscintigraphy)
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m pertechnetate
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Patient preparation
D. Equipment
   1. Imaging
   2. Ancillary
      a. Head immobilization device
      b. Dose administration device
E. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Sources of error
F. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Genitourinary System

I. Review of Anatomy and Physiology
   A. Gross anatomy and function
   B. Cellular anatomy and function
   C. Blood flow

II. Pathology
   A. Acute inflammatory disease
   B. Chronic inflammatory disease
   C. Acute tubular necrosis
   D. Congenital abnormalities
   E. Space-occupying lesions
   F. Renal cancers
   G. Renovascular disease
   H. Obstructive uropathies
   I. Renal transplant and rejection
   J. Vesicoureteral reflux
   K. Testicular torsion
   L. Inflammatory disease of the testes

III. Renal Perfusion (Functional Imaging)
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m sodium pertechnetate
         b. Tc-99m DTPA
         c. Tc-99m GH
         d. Tc-99m MAG3
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Kit and preparation
   D. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   E. Patient preparation
   F. Imaging equipment
   G. Protocol
      1. Dose range and administration technique
2. Acquisition parameters  
3. Positioning and views  
4. Data processing  
5. Image display/format  
6. Sources of error  

H. Interpretation of images  
1. Normal  
2. Normal variants  
3. Abnormal  
4. Artifacts  
5. Diagnostic/prognostic value of the study  
6. Evaluation of technical quality  
7. Correlative tests  
   a. Imaging  
   b. Nonimaging  

IV. Glomerular Filtration Rate and Effective Renal Plasma Flow  
A. Indications  
B. Radiopharmaceutical  
   1. Tracers  
      a. Tc-99m DTPA  
      b. Tc-99m MAG3  
      c. I-125 Iothalamate  
   2. Route of administration  
   3. Biodistribution  
      a. Uptake  
      b. Distribution  
      c. Excretion  
   4. Dosimetry  
C. Contraindications and adverse reactions  
   1. Physical conditions  
   2. Interfering studies  
   3. Possible interfering drugs  
   4. Precautions  
   5. Adverse reactions  
D. Patient preparation  
E. Equipment  
   1. Imaging equipment  
   2. Laboratory equipment  
F. Protocol  
   1. Dose range and administration technique  
   2. Acquisition parameters  
   3. Positioning and views  
   4. Data processing  
   5. Image display/format  
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

V. Morphological Imaging
   A. Indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Tc-99m DMSA
         b. Tc-99m GH
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocol
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
VI. Voiding Cystogram
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Tc-99m DTPA
      b. Tc-99m sulfur colloid
      c. Tc-99m sodium pertechnetate
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   a. Physical conditions
   b. Interfering studies
   c. Possible interfering drugs
   d. Precautions
   e. Adverse reactions
D. Patient preparation
E. Equipment
   1. Imaging equipment
   2. Laboratory equipment
F. Protocol
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VII. Testicular Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracer
      a. Tc-99m sodium pertechnetate
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Image display/format
   5. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Hematology and In Vitro

I. Review of Anatomy and Function
   A. Gross anatomy and function
   B. Cellular anatomy and function
   C. Life cycle of red and white blood cells

II. Total Blood Volume
   A. Red cell mass
      1. Indications
      2. Radiopharmaceutical
         a. Cr-51 sodium chromate
      3. Contraindications and adverse reactions
      4. Patient preparation
      5. Equipment
      6. Well counter
      7. Pipette
      8. Protocol
      9. Interpretation of results
   B. Plasma volume
      1. Indications
      2. Radiopharmaceutical
         a. I-125 human serum albumin/RISA
      3. Contraindications and adverse reactions
      4. Patient preparation
      5. Equipment
         a. Well counter
         b. Pipette
      6. Protocol
      7. Interpretation of results

III. Red Cell Survival and Sequestration
   A. Indications
   B. Radiopharmaceutical
      1. Cr-51 sodium chromate
   C. Contraindications and adverse reactions
   D. Patient preparation
   E. Equipment
      1. Uptake probe
      2. Anger camera
      3. Well counter
      4. Pipette
   F. Protocol
   G. Interpretation of results
Diagnostic Procedures: Respiratory System

I. Anatomy and Physiology
   A. Gross anatomy and function
   B. Cellular anatomy and function
   C. Blood flow

II. Pathology: For each of the following disease states, these topics will be covered: characteristics, causes, population, and treatment
   A. Pulmonary embolism
   B. Primary and secondary neoplasms
   C. Chronic obstructive pulmonary disease
      1. Asthma
      2. Emphysema
      3. Pneumoconiosis
      4. Chronic bronchitis
   D. Infectious diseases
      1. Tuberculosis
      2. Pneumonia
   E. Pulmonary edema
   F. Pleural effusion
   G. Sarcoidosis
   H. Atelectasis
   I. Congenital heart disease involving right-to-left cardiac shunt

III. Perfusion
   A. Indications
   B. Radiopharmaceutical
      1. Tracer
         a. Tc-99m MAA
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
   a. Standard lung imaging
   b. Right-to-left cardiac shunt
4. Data processing
5. Image display/format
6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

IV. Gas Ventilation
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. Xenon-133
      b. Krypton-81m
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Equipment
   1. Imaging
   2. Accessory
      a. Ventilation/trapping system
      b. Negative pressure room
      c. Room air monitor
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
3. Positioning and views
4. Image display/format
5. Sources of error

G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

V. Aerosol Ventilation
   A. Indications
   B. Radiopharmaceutical
      1. Tracers
         a. Nebulized Tc-99m DTPA
         b. Tc-99m Technegas
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Interfering studies
      3. Precautions
      4. Adverse reactions
   D. Patient preparation
   E. Equipment
      1. Imaging
      2. Aerosol system
      3. Technegas generator
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Image display/format
      5. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VI. Combined Ventilation/Perfusion Study
   A. Order of studies
   B. Interpretative criteria (probabilities)
   C. Diagnostic/prognostic value of the study

VII. Quantitative Lung Study
   A. Indications
   B. Protocols
      1. Dose range and administrative technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   C. Interpretation of images and data
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
         a. Imaging
         b. Nonimaging
Diagnostic Procedures: Infection and Inflammation

I. Anatomy and Physiology
   A. Immune process
   B. Lymph node distribution
   C. Inflammatory processes

II. Pathology: These topics will be covered: characteristics, causes, population, and treatment
    A. Inflammatory and infectious diseases

III. Radiolabeled White Blood Cell Studies
    A. Indications
    B. Radiopharmaceuticals
       1. Tracers
          a. In-111 oxine–tagged white blood cells
          b. Tc-99m hexametazime (HMPAO)-tagged white blood cells
       2. Route of administration
       3. Biodistribution
          a. Uptake
          b. Distribution
          c. Excretion
          d. Dosimetry
    C. Contraindications and adverse reactions
       1. Physical or pathologic conditions
       2. Interfering studies
       3. Precautions
       4. Adverse reactions
    D. Patient preparation
    E. Equipment
       1. Imaging
       2. Laboratory equipment for tagging process
    F. Protocols
       1. Dose range and administration technique
       2. Acquisition parameters
       3. Positioning and views
       4. Data processing
       5. Image display/format
       6. Sources of error
    G. Interpretation of images
       1. Normal
       2. Normal variants
       3. Abnormal
       4. Artifacts
       5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

IV. Gallium Imaging for Infection
   A. Indications
   B. Radiopharmaceutical
      1. Tracer
         a. Gallium-67 citrate
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
         a. Imaging
         b. Nonimaging

V. Bone Marrow Imaging
   A. Indications
   B. Radiopharmaceutical
      1. Tracer
         a. Tc-99m sulfur colloid
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Oncology

I. Anatomy and physiology
   A. Immune process
   B. Lymph node distribution
   C. Receptor physiology
   D. Malignant processes

II. Pathology: These topics will be covered: characteristics, causes, population, and treatment
   A. Malignant diseases

III. Gallium Imaging for Tumors
   A. Indications
   B. Radiopharmaceutical
      1. Tracer
         a. Gallium-67 citrate
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Precautions
      5. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
      4. Data processing
      5. Image display/format
      6. Sources of error
   G. Interpretation of images
      1. Normal
      2. Normal variants
      3. Abnormal
      4. Artifacts
      5. Diagnostic/prognostic value of the study
      6. Evaluation of technical quality
      7. Correlative tests
IV. Antibody Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. In-111 capromab pendetide (for prostate cancer)
      b. Other approved radiopharmaceuticals
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

V. Receptor Imaging
A. Indications
B. Radiopharmaceuticals
   1. Tracers
      a. In-111 pentetreotide
      b. Other approved radiopharmaceuticals
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Possible interfering drugs
   4. Precautions
   5. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error
G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

VI. Breast Imaging (Scintimammography and Breast-Specific Gamma Imaging)
A. Indications
B. Radiopharmaceutical
   1. Tracer
      a. Tc-99m sestamibi
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
2. Interfering studies
3. Precautions
4. Adverse reactions

D. Patient preparation

E. Equipment
1. Imaging
2. Palette—table overlay

F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
   a. Positioning
   b. Views
   c. Breast-specific gamma imaging
      i. Oblique
      ii. Cranial/caudal
      iii. Medial/lateral
   d. Scintimammography
      i. Anterior
      ii. Lateral
3. Image display/format
4. Sources of error

G. Interpretation of images
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VII. Sentinel Node Imaging

A. Indications

B. Radiopharmaceuticals
1. Tracers
   a. Tc-99m filtered sulfur colloid
2. Route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
4. Dosimetry

C. Contraindications and adverse reactions
1. Physical conditions
2. Interfering studies
3. Precautions
4. Adverse reactions

D. Patient preparation
E. Imaging equipment
F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Image display/format
5. Sources of error

G. Interpretation data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

VIII. Lymphoscintigraphy
A. Indications
B. Radiopharmaceutical
   1. Tracer
      a. Tc-99m filtered sulfur colloid
   2. Route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical conditions
   2. Interfering studies
   3. Precautions
   4. Adverse reactions
D. Patient preparation
E. Imaging equipment
F. Protocols
1. Dose range and administration technique
2. Acquisition parameters
3. Positioning and views
4. Image display/format
5. Sources of error
G. Interpretation data
1. Normal
2. Normal variants
3. Abnormal
4. Artifacts
5. Diagnostic/prognostic value of the study
6. Evaluation of technical quality
7. Correlative tests
   a. Imaging
   b. Nonimaging

IX. PET Imaging (PET and PET/CT)
   A. Indications
      1. Solitary pulmonary nodule
      2. Non–small cell lung cancer
      3. Small cell lung cancer
      4. Mesothelioma
      5. Myeloma
      6. Lymphoma
      7. Colorectal cancer
      8. Head and neck cancer
      9. Esophageal cancer
     10. Breast cancer
     11. Brain cancer
     12. Prostate cancer
     13. Cervical cancer
     14. Ovarian cancer
     15. Testicular cancer
     16. Thyroid cancer
     17. Pancreatic cancer
     18. Future indications
   B. Radiopharmaceutical
      1. Tracer
         a. Fluorine-18 fluorodeoxyglucose
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Precautions
      4. Adverse reactions
   D. Patient preparation
   E. Equipment
1. Imaging
   a. Emission
   b. Transmission
2. Glucometer

F. Protocols
   1. Dose range and administration technique
   2. Acquisition parameters
   3. Positioning and views
   4. Data processing
   5. Image display/format
   6. Sources of error

G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging

X. Thyroid Metastatic Survey (Whole Body Imaging)
   A. Indications
   B. Radiopharmaceutical
      1. Tracer
         a. Iodine-131 sodium iodide
         b. Iodine-123 sodium iodide
         c. Thallium-201
      2. Route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical conditions
      2. Interfering studies
      3. Possible interfering drugs
      4. Adverse reactions
   D. Patient preparation
   E. Imaging equipment
   F. Protocols
      1. Dose range and administration technique
      2. Acquisition parameters
      3. Positioning and views
4. Image display/format
5. Sources of error

G. Interpretation of images
   1. Normal
   2. Normal variants
   3. Abnormal
   4. Artifacts
   5. Diagnostic/prognostic value of the study
   6. Evaluation of technical quality
   7. Correlative tests
      a. Imaging
      b. Nonimaging
Diagnostic Procedures: Pediatrics

I. Technical Considerations
   A. Instrumentation
   B. Patient safety and care
   C. Immobilization techniques
   D. Patient-parent interaction
   E. Injection technique
   F. Radiopharmaceutical administered dose
   G. Positioning

II. Clinical Applications
   A. Skeletal system
   B. Genitourinary system
   C. Gastrointestinal system
   D. Cardiovascular system
   E. PET imaging

III. Potential Sources of Error in Pediatric PET
Chapter 14

Clinical Education
Clinical Education

Clinical experience integrates didactic learning into the practical setting. During their clinical education, students shall be under the supervision of certified or licensed technologists. Clinical experience should include rotations through general, cardiac, pediatric, positron emission tomography and positron emission tomography/computed tomography, single-photon emission computed tomography, and single-photon emission computed tomography/computed tomography. Ancillary rotations in magnetic resonance imaging and computed tomography to include the administration of contrast media are recommended. Students should observe and/or participate in the administration of contrast media. Students should progress through levels of responsibility/involvement moving from observation to performing as an entry-level technologist. They should become proficient in all aspects of Nuclear Medicine Technology.

Objectives:

1. Comply with relevant policies and procedures
2. Provide safe and proper patient care
3. Act in a professional and ethical manner
4. Practice safe and effective radiation protection techniques
5. Select the appropriate instrumentation for imaging procedure, perform quality control, and set up the proper protocol for use
6. Select the appropriate instrumentation for nonimaging procedure, perform quality control, and set up the proper protocol for use
7. Use the computer for processing and data analysis, perform quality control, and display the data in the appropriate format
8. Receive, prepare, administer, and properly dispose of the appropriate radiopharmaceutical in accordance with federal regulations
9. Perform diagnostic procedures according to accepted protocol
10. Participate in radionuclide therapy procedures according to accepted protocol
Clinical Education

I. Orientation
   A. Program policies and procedures
      1. Student handbook
      2. Evaluation mechanism/forms
   B. Other policies and procedures
      1. Facility/department
         a. Department protocol manual
         b. Facility layout and organization
         c. Day-to-day operations
      2. Fire safety
      3. Emergency codes
      4. Emergency cart and other emergency supplies
      5. Disaster procedures
      6. Occupational Safety and Health Administration Policies
      7. Health Insurance Portability and Accountability Act
      8. Sexual harassment
      9. Diversity training
     10. Other policies
   C. Departmental Organization and Administration
      1. Supplies
         a. Procurement
         b. Inventory/location
      2. Patient scheduling
      3. Records management (e.g., patient records, quality control documents)
      4. Licenses

II. Patient Care
   A. Patient communications and interactions
      1. Explanation of procedures
      2. Age/group-specific competencies
      3. Situation specific
   B. Verification of requisition/order
   C. Patient identification
   D. Patient assessment
      1. Patient history
         a. Medications
         b. Clinical laboratory values
         c. Pertinent physical history
      2. Preprocedural preparation
      3. Identification of possible contraindications
   E. Infection control
   F. Contamination control
   G. Patient support
1. Basic needs
2. Ancillary support equipment
   a. Intravenous lines and pumps
   b. Oxygen delivery regulators
   c. Glucometer
   d. Treadmill
   e. Pulse oximeter
   f. Catheters
      i. Peripheral inserted central catheter lines recognition
      ii. Central line catheter recognition
      iii. Other
   g. Drainage tubes
   h. Suction devices
   i. Traction devices
   j. Removable and nonremovable braces

H. Patient care competencies
   1. Vital signs
      a. Pulse
      b. Respiration
      c. Blood pressure
      d. Temperature
   2. Cardiopulmonary resuscitation with automatic external defibrillator certification
   3. Venipuncture
   4. Electrocardiograph
      a. Lead placement
      b. Recognition of normal sinus rhythm
      c. Recognition of common arrhythmias

I. Routes of administration in compliance with facility policy and state regulations
   1. Intravenous
   2. Intravenous catheter setup
   3. Oral
   4. Intramuscular
   5. Intrathecal
   6. Intracavitary
   7. Inhalation
   8. Subcutaneous
   9. Intradermal
   10. Topical

J. Adverse reactions
   1. Identification
   2. Response
   3. Report
III. Affective Domain
A. Professional relationships
   1. Cooperation and teamwork
   2. Professional etiquette
   3. Conflict management
B. Professional skills and behaviors
   1. Dependability
   2. Critical thinking
   3. Integrity
   4. Communication
   5. Adaptability
   6. Cooperation
   7. Interpersonal skills
   8. Self-confidence
   9. Initiative
   10. Efficiency
   11. Cultural competency
C. Professional appearance
D. Ethics and medicolegal considerations
   1. Respect for patient privacy
   2. Patient confidentiality
   3. Consent forms as applicable

IV. Radiation Protection
A. Proper use of a survey meter
B. Personnel monitoring
   1. Proper use of monitoring devices
   2. Personnel contamination surveys
   3. Knowledge and interpretation of radiation exposure reports
C. Practical methods of radiation protection
D. Radioactive package receipt and shipping
E. Radioactive waste disposal
F. Contamination monitoring
G. Decontamination procedures
H. Radionuclide therapy room preparation and cleanup
I. Proper labeling of and posting for radioactive materials and radiation areas
J. “As Low As Reasonably Achievable” philosophy

V. Instrumentation: Nonimaging
A. Geiger-Mueller counter operation and quality control
B. Well counter operation and quality control
C. Uptake probe operation and quality control
D. Dose calibrator operation and quality control
E. Portable ionization chamber operation and quality control
VI. Instrumentation: Imaging
   A. Selection of appropriate camera and collimator
   B. Selection of acquisition parameters on camera/computer
   C. Performance of quality control
      1. Uniformity
      2. Linearity
      3. Resolution
      4. Uniformity correction map
      5. Center of rotation

VII. Instrumentation: Computers
   A. Data processing
      1. Regions of interest
      2. Cardiac axis orientation
      3. Histogram/curve production
      4. Filter algorithms
      5. Reconstruction algorithms
      6. Comparative display of images
      7. Subtraction studies
      8. Contrast adjustment
      9. Motion correction
      10. Attenuation correction
      11. Coregistration
      12. Other
   B. Image display

VIII. Radiopharmacy
   A. Selection and confirmation of the appropriate radiopharmaceutical
   B. Quality control procedures
   C. Generator elution
   D. Syringe and vial labeling
   E. Kit preparation
   F. Equipment
      1. Centrifuge
      2. Pipettes
      3. Fume hood
      4. Microscope/hemocytometer
   G. Dose calculation and preparation
   H. Record management

IX. Diagnostic Procedures
   A. Imaging procedures
      1. Patient safety considerations
      2. Image acquisition at appropriate time
      3. Camera projections and patient positioning
4. Acquisition of additional views when applicable
5. Data processing
6. Image display
7. Image and data analysis for artifacts and errors
8. Image labeling
9. Presentation of completed study

B. Nonimaging procedures
   1. In vivo and in vitro counting
   2. Standard preparation
   3. Data calculation
   4. Presentation of completed study

X. Radionuclide Therapy: Due to liability and state/federal regulations and facility policy, students may only be able to observe these procedures
   A. Confirmation of patient identification
   B. Confirmation of written directive
   C. Dose verification
   D. Patient instructions
Chapter 15

Radionuclide Therapy
Radionuclide Therapy

There are an increasing number of clinical nuclear medicine procedures involving radionuclide therapy. These procedures demand special expertise for safe use and proper care of the patient. Students should understand the technologist’s role in the administration of radiopharmaceuticals in therapeutic doses, as well as associated imaging protocols.

Objectives:

1. Describe the common causes of pathologies of malignant diseases as they relate to radionuclide therapy
2. Recognize and explain clinical indications for therapeutic procedures
3. Describe and apply the appropriate therapeutic protocols
4. Evaluate images and/or quantitative data for technical quality, including artifacts, normal variants, and normal and altered biodistribution
Radionuclide Therapy

I. Introduction to Radionuclide Therapy
   A. Radionuclide physical properties
   B. Radiobiology

II. Review of Anatomy and Physiology
   A. Malignant processes
   B. Metastatic processes

III. Pathology: For each of the following, topics to be covered include characteristics, causes, population, and treatment
   A. Body cavities
      1. Malignancies
      2. Cavitary effusions
   B. Bone and bone marrow
      1. Leukemia
      2. Polycythemia vera
      3. Metastatic bone cancer
      4. Lymphoma
      5. Joint disease
   C. Thyroid
      1. Hyperthyroidism
      2. Thyroid carcinoma
   D. Non-Hodgkin’s lymphoma

IV. Intracavitary Palliation
   A. Clinical indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Phosphorus-32 chromic phosphate
      2. Dose range and route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
         d. Factors affecting biodistribution
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Precautions
      3. Adverse reactions
   D. Radiation safety considerations and regulations
   E. Patient preparation including consent
   F. Equipment
   G. Basic procedure and processing
1. Protocols
2. Dose range and administration technique
3. Acquisition parameters
4. Positioning and views, including adaptations
5. Image formatting
6. Sources of error

H. Interpretation of images
   1. Evaluation of tracer distribution
   2. Prognostic value (outcome)

V. Bone Marrow Palliation
   A. Clinical indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Phosphorus-32 sodium phosphate
      2. Dose range and route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
         c. Excretion
         d. Factors affecting biodistribution
      4. Dosimetry
   C. Contraindications and adverse reactions
      1. Physical and pathologic conditions
      2. Precautions
      3. Adverse reactions
   D. Radiation safety considerations and regulations
   E. Patient preparation including consent
   F. Basic procedure
      1. Protocols
      2. Dose range and administration technique
      3. Sources of error
   G. Prognostic value
      1. Outcomes
      2. Treatment decisions
      3. Prognostic risk factors based on diagnosis

VI. Ablation for Hyperthyroidism
   A. Clinical indications
   B. Radiopharmaceuticals
      1. Tracers
         a. Iodine-131 sodium iodide
      2. Dose range and route of administration
      3. Biodistribution
         a. Uptake
         b. Distribution
c. Excretion
4. Factors affecting biodistribution
5. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation safety considerations and regulations
E. Patient preparation including consent
F. Basic procedure
   1. Protocols
   2. Dose range and administration technique
   3. Sources of error
G. Prognostic value
   1. Outcomes
   2. Treatment decisions
   3. Prognostic risk factors based on diagnosis

VII. Thyroid Carcinoma Ablation
A. Clinical indications
B. Radiopharmaceuticals
   1. Tracers
      a. Iodine-131 sodium iodide
   2. Dose range and route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
      d. Factors affecting biodistribution
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation safety considerations and regulations
E. Patient preparation including consent
F. Basic procedure
   1. Protocols
   2. Dose range and administration technique
   3. Sources of error
G. Prognostic value
   1. Outcomes
2. Treatment decisions
3. Prognostic risk factors based on diagnosis

VIII. Palliation of Metastatic Bone Pain
A. Clinical indications
B. Radiopharmaceuticals
   1. Tracers
      a. Strontium-89 chloride
      b. Samarium-153 EDTMP
      c. P-32 sodium phosphate
   2. Dose and route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
      d. Factors affecting biodistribution
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation safety considerations and regulations
E. Patient preparation including consent
F. Equipment (if applicable)
G. Basic procedure and processing
   1. Protocols
   2. Dose range and administration technique
   3. Acquisition parameters
   4. Positioning and views, including adaptations
   5. Image formatting
   6. Sources of error
H. Interpretation of images (if applicable)
   1. Distribution
   2. Artifacts
I. Diagnostic/prognostic value of the study
   1. Outcomes
   2. Treatment decisions
   3. Prognostic risk factors based on diagnosis

IX. Radiosynoviorthesis
A. Clinical indications
B. Radiopharmaceuticals
   1. Tracers
      a. Colloidal Phosphorus-32
2. Dose range and route of administration
3. Biodistribution
   a. Uptake
   b. Distribution
   c. Excretion
   d. Factors affecting biodistribution
4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation safety considerations and regulations
E. Patient preparation including consent
F. Basic procedure
   1. Protocols
   2. Dose range and administration technique
   3. Sources of error
G. Prognostic value
   1. Outcomes
   2. Treatment decisions
   3. Prognostic risk factors based on diagnosis

X. Radiolabeled Monoclonal Antibody Therapies
A. Clinical indications
B. Radiopharmaceuticals
   1. Tracers
      a. I-131 tositumomab
      b. Y-90 ibritumomab with In-111 ibritumomab
   2. Dose and route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
      d. Factors affecting biodistribution
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation considerations and regulations
E. Patient preparation including consent
F. Equipment
G. Basic procedure and processing
   1. Protocols
   2. Dose range and administration techniques
   3. Acquisition parameters
   4. Positioning and views
   5. Image formatting
   6. Sources of error

H. Interpretation of images
   1. Rationale for imaging
   2. Biodistribution

I. Prognostic value
   1. Outcomes
   2. Treatment decisions
   3. Prognostic risk factors based on diagnosis

XI. Y-90 Microspheres
A. Clinical indications
B. Radiopharmaceuticals
   1. Tracers
      a. Y-90 microspheres
   2. Dose and route of administration
   3. Biodistribution
      a. Uptake
      b. Distribution
      c. Excretion
      d. Factors affecting biodistribution
   4. Dosimetry
C. Contraindications and adverse reactions
   1. Physical and pathologic conditions
   2. Interfering studies
   3. Interfering drugs
   4. Precautions
   5. Adverse reactions
D. Radiation considerations and regulations
E. Patient preparation including consent
F. Equipment
G. Basic procedure and processing
   1. Protocols
   2. Dose range and administration techniques
   3. Acquisition parameters
   4. Positioning and views
   5. Image formatting
   6. Sources of error
H. Prognostic value
   1. Outcomes
   2. Treatment decisions
3. Prognostic risk factors based on diagnosis
Chapter 16

Emerging Technologies
Emerging Technologies

The field of Nuclear Medicine Technology is experiencing change at an exponential rate. While it is difficult to anticipate what new and emerging technologies will become tomorrow’s standard of practice, the student should be given an introduction to these ideologies.

Objectives:

1. Describe and discuss instrumentation in emerging technologies and how it relates to current practice
2. Describe and discuss diagnostic and therapeutic procedures in emerging technologies and how they relate to current practice
3. Describe and discuss radiopharmaceuticals in emerging technologies and how they relate to current practice
4. Recognize and identify artifacts and their causes found in emerging technologies
5. Discuss issues related to schedule sequence, reimbursement, and regulations associated with emerging technologies
Emerging Technologies

I. Positron Emission Tomography/Magnetic Resonance Imaging
   A. Magnetic physics
   B. Instrumentation
      1. Theory of operation
      2. Acquisition modes
      3. Image formation and reconstruction
   C. Diagnostic procedures
      1. Radiopharmaceuticals
      2. Contrast agents
   D. Artifacts
      1. Normal variants
      2. Physiologic artifacts
      3. Image registration
   E. Other
      1. Scheduling sequence
      2. Reimbursement Issues
      3. Regulations

II. Positron Emission Mammography
   A. Instrumentation
      1. Theory of operation
      2. Acquisition modes
      3. Image formation and reconstruction
   B. Diagnostic procedures
      1. Radiopharmaceuticals
      2. Contrast agents
   C. Artifacts
      1. Normal variants
      2. Physiologic artifacts
      3. Image registration
   D. Other
      1. Scheduling sequence
      2. Reimbursement issues
      3. Regulations

III. Optical Imaging
   A. Instrumentation
      1. Theory of operation
      2. Acquisition modes
      3. Image formation and reconstruction
   B. Diagnostic procedures
      1. Radiopharmaceuticals
      2. Contrast agents
   C. Artifacts
CURRICULUM GUIDE

1. Normal variants
2. Physiologic artifacts
3. Image registration

D. Other
1. Scheduling sequence
2. Reimbursement issues
3. Regulations

IV. Other Technologies
A. Radiation therapy treatment planning
   1. Positron emission tomography/computed tomography
   2. Positron emission tomography/magnetic resonance imaging
B. Nanotechnology
   1. Production of radiopharmaceuticals
C. New radiopharmaceuticals
D. Other technology
**Society of Nuclear Medicine Technologist Section Code of Ethics**

Nuclear Medicine Technologists, as members of the health care profession, must strive as individuals and as a group to maintain the highest of ethical standards. The principles (Society of Nuclear Medicine Technologist Section Code of Ethics) listed below are not laws, but standards of conduct to be used as ethical guidelines by Nuclear Medicine Technologists.

| Principle 1 | The Nuclear Medicine Technologist will provide services with compassion and respect for the dignity of the individual and with the intent to provide the highest quality of patient care. |
| Principle 2 | The Nuclear Medicine Technologist will provide care without discrimination regarding the nature of the illness or disease, gender, race, religion, sexual preference or socioeconomic status of the patient. |
| Principle 3 | The Nuclear Medicine Technologist will maintain strict patient confidentiality in accordance with state and federal regulations. |
| Principle 4 | The Nuclear Medicine Technologist will comply with the laws, regulations, and policies governing the practice of nuclear medicine. |
| Principle 5 | The Nuclear Medicine Technologist will continually strive to improve their knowledge and technical skills. |
| Principle 6 | The Nuclear Medicine Technologist will not engage in fraud, deception, or criminal activities. |
| Principle 7 | The Nuclear Medicine Technologist will be an advocate for their profession. |

References


CT Cross Trainer


Hall, *Radiology for the Radiologist*


Travis EL. Primer of Medical Radiobiology. 2nd ed. Chicago, IL: Year Book Medical Publishers; 1989.


Wilson BG. Ethics and Basic Law For Medical Imaging Professionals. F. A. Davis; 1997.


Online Resources

American Society of Radiation Technologists Bachelor of Science in Radiologic Sciences Curriculum
https://www.asrt.org/content/Educators/Curricula/BSRS/BSRS.aspx

Aunt Minnie

Mallinckrodt Teaching Files
http://gamma.wustl.edu/allknown.html

Hot Links

The following links will be added upon approval of the Curriculum Guide, 4th Edition.

www.snm.org
www.nmtcb.org
www.arrt.org
www.crcpd.org
www.nrc.gov
Mentoring Program
(Separate Packet will be Distributed)
<table>
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Leadership Academy Task Force
Nominating Committee Report
PDEF Update
Committee Charges for 2007-2008:

Organized in 2001 by the Society of Nuclear Medicine Technologists Section, the Professional Development and Education Fund (PDEF) supports the advancement and practices of nuclear medicine technology. Executive Council members assist with fundraising for PDEF, approve programs and activities for the fund to support, and provide oversight over the proper accounting and disbursement of funds. The committee is charged with:

- Ensuring an adequate supply of qualified nuclear medicine technologists
- Encouraging research studies, publications, and papers in nuclear medicine technology that promote the development of best-practice techniques
- Advancing the educational background of clinical nuclear medicine instructors, practicing nuclear medicine technologists, and those just entering the field
- Advancing the education and research programs of SNMTS

Current Working Objectives/Goals (please reference Strategic Plan):

The PDEF’s work relates most closely to the Goal A of the Strategic Plan, which states: “SNM will be members’ indispensable resource for education, knowledge exchange, training and networking.” PDEF has established two objectives for this fiscal year:

1. Ensure the PDEF supports the SNMTS strategic goals for education and professional development.
2. Review the PDEF Corporate Friends initiative in conjunction with the SNMTS strategic planning process as a way of strengthening this initiative.

Progress of Charge/Objectives/Goals to Date:

- In addition to continuing to fund the Mickey Williams Minority Student Scholarships and Travel Awards for 2008, two key educational programs were approved by the committee for funding this year. The programs are the creation of Review Courses and Mock Exams for each of the two specialty exams offered by the NMTCB, which are the Positron Emission Tomography (PET) exam and the Nuclear Cardiology Technology (NCT) exam. The courses and mock exams will be presented as annual workshops.
- Another project that PDEF would like to fund this year is the SNMTS Leadership Academy. The academy will actively work on building a team of 15-20 technologists each year who have demonstrated leadership abilities and engagement at the chapter level. The SNMTS Leadership Academy’s training will focus on setting a clear plan for increasing leadership abilities by developing the necessary skills and organizational expertise to enhance chapter performance and, ultimately, evolve to national leadership. The Leadership Academy is a place where current and future leaders can gain knowledge in fundamental leadership techniques from professionally recognized leadership groups as well as current SNMTS leadership.
- PDEF continue to work to secure corporate commitments for continued funding of these and other important projects. In the last three months, the following companies have been solicited:

Committee Report
SNMTS Executive Board
June 13, 2008
Professional Development and Education Fund
- Lantheus, formerly BMS (scheduling visit) Don Kiepert, President
- Segami (scheduling visit) Simon DeBruin
- PetNet (scheduling visit) Nilda Rivera
- Triad Isotopes (considering and request) Steve Belcher
- MDS Nordion (will visit at Annual Meeting) Tom Burnett
- Anazao Health (considering a commitment) Samantha Platt

- The following companies have made commitments this month:
  - Capintec $5,000
  - Covidien $5,000

**Additional Goals/Objectives Added for 2007-2008:**

The Board is currently looking to various committees to put forth fundable projects that are in alignment with the strategic plan. Once these funding priorities are determined, the committee will identify outcome measures that can be tied to each priority. Once the funding priorities are determined and aligned with the strategic plan, the committee will establish a position on how industry will benefit from supporting these project initiatives."
Reports from the Leadership
SNMTS President
SNMTS President-Elect
SNMTS President-Elect’s Report
2008 Annual Meeting
New Orleans, LA

From: Mark Wallenmeyer, MBA, CNMT, RT(N)

Date: June 2008

The beginning of my tem as President-Elect has been very busy. I first want to thank President David Gilmore for involving me and getting me prepared to take the realms at the Annual Meeting coming up in New Orleans. Below is a list of Chapter and SNMTS related meetings that I have attended as a representative of the SNMTS leadership.

Chapter Meetings:

- March 6-8 – Atlantic City, NJ (Greater NY) - Speaker
- March 26-30 – Little Rock, AR (Southwest) - Speaker
- April 5-6 – Milwaukee, WI (Central Chapter) - Speaker

SNMTS Related Meetings:

- March 9 – RT in DC – Washington, DC
- March 10-11 – Committee meeting – Reston, VA
- April 1-4 – HPN – Baltimore, MD
- April 17-18 – MSRT – Lake Ozark, MO - Speaker
- April 25-27 – SNM BOD, SNMTS Exec Board – Reston, VA
- May 9-10 – SNM/SNMTS Management Fee Allocation Task Force – Reston, VA

Activities and Issues within the SNMTS:

- Attended RT in DC
- Continued efforts have been made and push for advancement of the CARE bill
- Attended the Missouri State Radiologic Society annual meeting in Lake of the Ozark, Missouri
- Committee Chair appointments
- Committee Roster appointments
- SNMTS appointments to the SNM committees
Admittedly, there has not been a whole lot of activity since the last report at the Mid-Winter Meeting. Since then, I have spent most of my time working on committee appointments (both Chair and committee members) and looking at the strategic plan to keep the goals of the committee in line with the strategic plan. My committee chairs are now set and are as follows:

<table>
<thead>
<tr>
<th>Committee/Task Force</th>
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<tr>
<td><strong>SNMTS Advocacy</strong></td>
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<td>Bylaws</td>
<td>Michelle Panichi-Egberts</td>
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<td>Scholarships, Grants and Awards</td>
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<td>Vesper Grantham</td>
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<td>Cindi Luckett-Gilbert</td>
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<td>Membership</td>
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<td>Nominating</td>
<td>David Gilmore (Immed Past-President)</td>
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<td>Program</td>
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<td>PDEF</td>
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<td>Technologist Abstracts</td>
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<td>Coding/Reimbursement</td>
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<td>Elpida Crawford / Lyn Roy</td>
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<td>Commission on Radiopharmaceuticals</td>
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<td>Procedure Guidelines</td>
<td>Dan Guarasci</td>
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<td>Art Maune / Donna Mars</td>
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This year, the SNM and the SNMTS will add a new committee. The committee is the “Membership” committee. The SNMTS will continue to have its regular membership committee made up of the chapter presidents and executive directors. This new committee will be made up of 4 members from the SNM and 4 members from the SNMTS. Each section will have a co-chair. I have selected:

Combined Membership         Nancy Burchell

This concept has been tried in the past and the technologists have felt that we ended up doing most of the work in combined committees. There has been extensive discussion with Robert Atcher, Ph.D. President-elect of the SNM in regards to this. He is aware of the concerns and has agreed to keep an eye on the committee to help prevent this from happening this year.

We are now in the 2nd year of the 5 year strategic plan. We need to continually look at this to make sure that we are on track for our 3 and 5 year goals (which are now only 1 and 3 years away). During the course of the year, I will be forming a new task force to address any issues and re-write the strategic plan to reflect what we have accomplished and where we intend to be as a technologist section. This task force will be charged with coming to the 2009 Annual meeting with a updated strategic plan.

The NCOR recommended that a task force be formed to address issues talked about at the 2008 Midwinter meeting. As stated at the MWM, these issues have been included in the 2008-2009 committee charges. The committee that will take charge of the issue is listed below.

1. Leadership Issues: Getting new leaders involved at the chapter level. (Task Force on Professional Development)
   The leadership academy that was started last year will now be expanded to the chapter level. The first year of the leadership academy was a test year. Participants were selected by national leadership. The success of this program is evident in that all but one of the 15 participants were on the national ballot this year. Because of the success of this program, the leadership academy has been extended to the chapter level. Any chapter can now recommend someone from their chapter to participate in the leadership academy. Currently, participation in the academy is at no charge to the chapters. This allows chapters to identify potential new leaders and get them some leadership training.
   One suggestion was to offer scholarships or awards. The scholarships, awards and grants committee, along with the ERF, has approved many new travel grants to technologists who have papers accepted at the annual meeting, as well as new scholarships for professional advancement. Technologists who are pursuing additional training or are working on an advanced degree now have the opportunity to apply for these grants. The deadline for these applications is May 30 of each year.

2. Corporate Support: Decreasing number of corporate supporters at the chapter level.
   (Membership Committee)
   Teri Pinkham will be giving a talk this year (Friday afternoon) at the Committee on Chapters about how to ask for donations from corporate sponsors. This is across the board. Not only are the chapters feeling it, but the SNM is as well.
3. Training and Licensure issues: PET/CT licensure laws in each state. (Advocacy)
   This is an ongoing issue. The SNMTS supports the CARE bill and is getting bi-weekly updates as to the progress. We found out that just last week, New Jersey is getting ready to introduce a bill that will give the state more authority to address the issue of who is allowed to perform the CT portion of a PET/CT scan.

   Coming from the membership, several items have come to the forefront recently that I would like to address:

   1. A. Can the ongoing and past resolutions that have been passed by the NCOR and Executive Board be made available on the SNM website?
      The answer to this question is yes. Currently the SNM office has a notebook of current and past resolutions. I brought this issue up with the staff and we do not see a problem. However, we would like to do a little further investigating as to the best way to do. Please look for this update in the near future.
   B. Who reviews resolutions to ensure that the leadership understands previous recommendations and resolutions before moving an item to action?
      Because we are an organization of volunteers and we do turn over, we rely on the staff, specifically the higher-level staff to review any resolution and give us feedback on what has been done in the past. Many of us volunteers have been in a leadership position of one type or another for a number of years. We also rely on discussing possible resolutions with past-presidents to get their input on issues.
   C. Who reviews the resolutions to ensure outdated resolutions are sunset or re-adopted?
      Again, this is a staff issue. We rely on Nikki and Virginia to review these. Unless a resolution has been either rescinded or superseded by another resolution, it will still be in effect.

2. Long term solution to future technetium availability issues.
   The SNM has been doing research on the availability of technetium in the United States in future years. Currently there is no published material, but I assure you that the SNM is looking into the possibility of U.S. supply of Molybdenum. We cannot afford another situation that arose from the Chalk River incident.

3. SNMTS should have a representative at local chapter meetings similar to our vendors to answer questions and promotion.
   Currently, the SNMTS leadership is trying to have a representative at every chapter meeting. I personally have been to the Missouri Valley, Greater New York, Southwest and Central Chapter meetings over the past year. I know that David has been to several as well. Many of these chapter meetings, we have been invited to give an update at the business meeting. Along with the SNMTS, the SNM has made an effort to get someone from their leadership to each meeting as well. If a member of the SNMTS leadership was not at your chapter meeting this past year, It may have been that the meeting coincided with another meeting or another SNM activity. Please let us know the dates to your meeting as soon as possible. We can get these dates on the calendar early to avoid possible conflicts. Also, if the chapter would like for leadership to
give an update from national at the business meeting, please let us know. Similarly, SNM staff has been at several chapter meetings in the past year. Staff does not go to the chapter meetings regularly.

I would like to take this opportunity to congratulate Cybil Nielsen on becoming the President-elect of the Technologist Section. Congratulations to all others who the elections as well. And if you did not win, I encourage you to try again. We are an organization of volunteers. Your help is greatly appreciated.

Mark Wallenmeyer, MBA, CNMT, RT(N)
President-Elect, SNMTS
SNMTS Immediate Past President
SNM President-Elect
SNM Vice-President
SNM Staff Reports
SNM Chief Executive Officer
Associate Director, Leadership Services
Informational Reports
Advocacy Committee
Committee Charges for 2007-2008:

1. Educate SHPLs, members, and the public of issues important to the nuclear medicine molecular imaging professions by offering lectures, newsletters, and articles

2. Grow the SHPL program to enhance grassroots efforts

3. Communicate with lawmakers to promote the SNMTS position on issues important to our profession

4. Collaborate with other like-minded organizations in the effort to advance our advocacy initiatives

5. Prepare resources for the membership and public regarding advocacy issues

Current Working Objectives/Goals:

1. Find a representative from each state as a resource when questions come into the SNM regarding state specific issues

2. Send monthly e-newsletters including SHPLs, HPRA, Chapters

3. Represent the SNMTS Advocacy at each Chapter’s meetings for lectures and education in conjunction with HPRA

4. Communicate with Chapters and NCDs on a regular basis to maintain knowledge flow of current events and issues brought before the Advocacy Committee

5. Communicate with SHPLs via newsletters and issue updates at least monthly to keep them current and motivated

6. Attend Alliance Meetings & CRCPD Meetings as representatives of the SNMTS Advocacy Committee

Progress of Charge/Objectives/Goals to Date:

- CARE Bill update: At this writing, the enforcement section of the S.1042 paragraph h is still not added back to the bill. The House of Representatives has not yet pulled section h out of HR 583 but it is expected to do so. The CARE bill has reached 10 years of effort trying to pass these minimum education standards.

- In cooperation with Alliance for Quality Imaging and Radiation Therapy (AQMIRT) the SNMTS Also the Alliance is working through its differences in accreditation opinions which has been tabled until the CARE bill passes.
• The final revision of the USP-797 was released in December 2007 which will make a major impact on the way nuclear medicine hot laboratories operate. Little information has come from the SNM to assist the SNMTS with helping to distribute implementation material or to help determine what impact this has on rural nuclear medicine hot laboratories.

• The University Health Consortium has drafted a white paper called The Medication Reconciliation Project to define and provide its opinion of medication reconciliation to The Joint Commission. The Advocacy chair participated in this draft representing the SNMTS.

• March 9-11, 2008 the ASRT’s RT in DC was held. 11 of NMTs participated. It was during this time attendees learned about the removal of paragraph h in S.1042.

• The CRCPD Board of Directors asked the SNMTS Advocacy Chair to present a twenty minute presentation at its Annual Meeting at the May 2008 meeting in Orlando, Florida to discuss the CARE bill as well as participate in the State Suggest Regulations Z-Medical Credentialing Committee. One of the Advocacy Committee goals is to expand the relationship with the CRCPD by including at least one representative from the SNM in order to assist the CRCPD with its goals as well as use their resources for the SNM and SNMTS’ needs.

• The SNMTS sent a letter to Mayor Bloomberg of New York City opposing its desire to enact a regulation prohibiting unauthorized persons to operate radiation detectors.

• The committee will have a CE session at the Annual Meeting Tuesday, June 17th from 9:45 am to 2:00 pm with lectures such as Medication Management, USP-797 implementation, The Joint Commission National Patient Safety Goals, and the CARE Bill.

• Locating state regulatory representatives from each state and have 20% completed.

• Revitalizing SHPLs by renaming them the Key Advocates and asking them to take on greater responsibilities such as completing monthly assignments and reporting back to Government Relations. Progress has been slow due to low response from former SHPLs.

Additional Goals/Objectives Added for 2007-2008:

• Drafting a 3 year strategic plan for the committee – in process
Advanced Practice Task Force
Committee Charges for 2007-2008:

This task force is responsible for developing and implementing an educational and credentialing pathway for advanced practice Nuclear Medicine Technologists.

Current Working Objectives/Goals (SNMTS Goals A1:1,2,3; A4:1,2; D2:1-7):

- Select a title for the advanced practice position
- Work with credentialing organizations to ensure an examination
- Work with accrediting organizations to ensure education programs
- Uncover obstacles to practice issues at the state level
- Implement at least one masters level education program by end of 2008
- Develop a professional curriculum for the advanced level position.

Progress of Charge/Objectives/Goals to Date:

- A title has been selected for the advanced practice position – Nuclear Medicine Advanced Associate.
- All activities are done in collaboration with members of the NMTCB and ARRT regarding Task Force progress. Both groups were provided with results from a survey conducted in January 2008 regarding interest on the part of BS NMT program directors in establishing NMAA programs.
- Similarly, the Task Force has collaborated with the JRCNMT to meetings regarding the advanced practice position and has kept the organization updated on progress.
- Three schools are currently working in collaboration to initiate a masters level program by the end of 2008.
- The professional curriculum has been drafted and is being reviewed by physicians in preparation for presentation to the Executive Board and Board of Directors for approval at the at the 2008 Annual Meeting.

Additional Goals/Objectives Added for 2007-2008:

No additional goals/objectives have been added to date.
Committee Charges for 2007-2008:
1. Maintain the Bylaws and Procedures of the SNMTS.

2. Review all proposed amendments to the Bylaws and report them to the Executive Board, as well as the National Council.

Current Working Objectives/Goals:
1. Update SNM Procedure Manual to be consistent with current SNMTS Bylaws (as revised June 2007).

Progress of Charge/Objectives/Goals to Date:
1. The SNMTS Bylaws Chair is currently reviewing the policy manual and suggesting changes. The Bylaws committee (current and 2008-2009 committee) will meet at the Annual Meeting to discuss the proposed changes.

Additional Goals/Objectives Added for 2007-2008:
None at this time.
Education Committee
Committee Charges for 2007-2008:
The Committee will concern itself with all phases of continuing education activities of the Section and make recommendations concerning continuing education for technologists to the President and Executive Board when required. The Committee is responsible for:

- Reviewing and monitoring VOICE approved activities sponsored by SNMTS ensuring they are in compliance with the ARRT and NMTCB continuing education guidelines.

- Collaborate with SNMTS Committees, Task Forces, and Learning Center Faculty to develop and implement continuing education and professional development materials across the career continuum of nuclear medicine technologists.

- Make recommendations regarding continuing education for emerging technologies.

- Review CE master plan to ensure that education programs are met.

Current Working Objectives/Goals (SNMTs Goals A1: 1,2,3; A3:2; A4:1,2; D1: 1-7):

- Review and monitor all phases of continuing education activities of the SNMTS
- Develop review courses for the nuclear cardiology and PET certification exams
- Enhance on-line programs to meet the minimum standards for tech participation required by the ARRT
- Develop additional areas to address emerging technologies (PET/MRI, PET/mammography) and advanced practice.

Progress of Charge/Objectives/Goals to Date:

- Planned and developed nuclear cardiology and PET certification review courses for 2008.
- Reviewed educational activity concepts that will meet technologists’ needs.
- Reviewed the following for VOICE credit:
  - 6 SNM directly sponsored activities
  - 10 Chapter and Affiliate meetings
  - 15 Sub Chapter meetings
  - 35 Industry sponsored activities
  - 43 Academic Institution/Hospital activities

Additional Goals/Objectives Added for 2007-2008:

Submit application to ARRT for Category A+ RCEEM status.
Educator’s Task Force
Committee Report
SNMTS Executive Board
June 13, 2008
Educators Task Force

Committee Charges for 2007-2008:
The charge of this Task Force is to provide a forum to discuss, assess and address various issues common to nuclear medicine and medical imaging educators and students. The Task Force is responsible for

- Developing programs and activities to support educators
- Take on the responsibilities formerly owned by the Entry-Level Task Force
- Work closely with the Advanced Practice Task Force
- Nominate SNMTS representatives to the JRCNMT Board
- Recommend continuing education and academic preparation classes
- Exchange ideas in nuclear medicine technology (best practices and current models)
- Recommend revisions to the JRCNMT "Essentials and Standards."

Current Working Objectives/Goals (SNMTs Goals A1: 1,2,3; A3:2; A4:1,2; D1: 1-7):

Curriculum Subcommittee
- Develop the professional curriculum for the entry-level technologist program
- Develop programmatic implementation of curriculum
- Work with stakeholders to implement curriculum
- Work with credentialing and accrediting organizations on entry-level curriculum and requirements

Educators and Students Subcommittee
- Oversee educators and students activities at Annual Meeting
  - Plan Educators’ Forums
  - Plan Students and Educators Luncheon
  - Coordinate the NMTCB review course and mock exam
  - Review student abstracts and judge oral and poster presentations
- Develop a document that delineates the Essential Functions of a Nuclear Medicine Technology
- Support and recommend continuing education activities that will meet the needs of practicing technologists to enhance their skills in new and emerging technologies
- Create an educators’ link on the SNM Website for educators to share materials and information

Outreach Subcommittee
- Publicize the new professional curriculum
- Create presentations for speakers to use at local events to discuss the new professional curriculum and entry-level education
- Maintain HOSA speakers

Progress of Charge/Objectives/Goals to Date:

Curriculum Subcommittee
- The final draft of the entry-level professional curriculum will be presented to the Boards for approval at the 2008 Annual Meeting.

Educators and Students Subcommittee
- Three Forums have been planned: 1) instructional design, curriculum development, and inter-professional team approach to education; 2) updates on entry-level and advanced practice initiatives and updates on subcommittee activities; 3) JRCNMT Forum.
A few student technologist posters will be displayed in the Poster Hall. This is the first year a Poster only option was offered to technologist student abstract submitters.

Development of a document delineating the Essential Functions of an NMT continues to be in progress.

A recommendation for education in PET/CT at the undergraduate level has been proposed in order to obtain grant funds for programs that may wish to initiate this training. The proposal received endorsement from the Executive Board and is now before the MI Awards Committee for consideration and approval.

An E-community for SNMTS member technologist educators has been launched and educators are already taking advantage of this resource for exchanging information.

Outreach Subcommittee

A presentation on the entry-level recommendation has been developed and approved by the Executive Board. Invitations have been sent to prospective speakers and letters have been sent to all technologist chapter presidents and presidents-elect for their information. The presentation has been approved for 1.0 Category A credits. An online version is in progress that will include post-test questions to allow technologists to learn about the entry-level initiative and professional curriculum while earning free a VOICE credit.

The Task Force has assumed responsibility for the HOSA meetings and faculty have been selected for this year’s meetings

Additional Goals/Objectives Added for 2007-2008:

No additional goals/objectives have been added to date.
Membership Committee
Committee Report  
SNMTS Executive Board  
June 13, 2008  
Membership Committee

Committee Charges for 2007-2008:  
This committee is responsible for promoting membership in the SNMTS, retain members, and seek ways to expand the services and benefits available to members of the nuclear medicine community as an enticement to membership in the SNMTS. This committee will also increase the awareness of nuclear medicine technology and the Technologist Section, thereby attracting new members and retaining current members and increasing the profile of the Technologist Section as the leading organization in the field of nuclear medicine technology.

- Updating Chapter information
- SNMTS Membership categories
- Promote membership
- Mentor new leaders
- Approve Fellow Awards

Current Working Objectives/Goals

1. Updating Chapter information  
   a. Develop a protocol that the chapters and SNM staff can follow to ensure that all chapter information is up to date.
   b. This item will not require executive board approval as it does not require a bylaws change. We simply need to develop a procedure that works well with the chapters and staff.
   c. Sub-committee is charged with working with Chapter ED’s, Chapter Presidents and SNM staff to develop this protocol.
   d. Check and balance system should be considered to ensure compliance.

2. SNMTS Membership categories  
   a. Review all membership categories and make recommendations for changes.
   b. This item WILL require executive board approval and a bylaws change. Therefore, this item must be complete by the mid-winter meeting so that it may be included in the ballot for a vote of the general membership.
   c. Sub-committee will be charged with looking at all categories of membership and making recommendations.
   d. Special attention should be paid to the Lifetime membership. What is the benefits to this category? If you have to be 55 and have been in the SNMTS for 20 years, and have to pay $2000, that is equal to paying normal dues to the age of 73. Most people would have exited the field of NM by that time and would be emeritus status anyway. Should this category exist for technologists? If so, what should the requirements/pricing be?
   e. Special attention should be paid to the Technologist (Regular) and Associate Technologist categories. The Associate Technologist has voting rights on the SNM side, whereas the Technologist (Regular) does not. The members present were concerned about having two separate categories for techs. I personally feel there needs to be this separation because of voting rights, however, will open this issue up for discussion among committee members.
   f. Special attention should be paid to the Fellow status. Currently, there is no benefit to this category. There are no dues increase, but the applicant pays $100 for the application. The committee should look at possible benefits to the fellow status besides the initials behind their name.
3. **Promote membership**  
a. Develop a strategy to retain new members and increase the membership on the chapter level by welcoming new members and communicating with local splinter groups.

   b. This item will not require executive board approval.

   c. Sub-committee will be charged with developing strategies to reach these groups. These strategies can be implemented at the chapter level.

   d. Committee Chair will develop a PowerPoint presentation about membership and the benefits of membership that can be distributed to chapters for presentation at their chapter meetings.

4. **Chapter requests**  
a. Develop a proposal to present to the PDEF for a grant/scholarship to help offset the speakers costs for chapter meetings.

   b. This item will not require executive board approval.

   c. Sub-committee will be charged with developing a proposal that can be sent to the PDEF for approval.

5. **Chapters should get involved with tier local groups.**  
a. Poll the members of your chapter and find out what local groups exist.

   b. Make a concerted effort to send one of the chapter leaders to the meetings of these groups.

6. **Mentor new leaders**  
a. I encourage chapter leaders to be on the lookout for potential new leaders. There are a lot of them out there, they just don’t know where to start. Talk to as many chapter members as you can and offer ideas/support as you can.

   b. FOLLOW UP with these people. Communication is the key.

7. **SNMTS leadership will look at when the awards are given and see what the possibilities are of combining the SNM and SNMTS awards ceremony.**

**Progress of Charge/Objectives/Goals to Date:**

**Updating Chapter Information**

This charge is ongoing. Currently, the chapters have the ability to update their chapter information online. Current work is underway to define a better communication between staff and chapters.

**SNMTS Membership Categories**

The membership committee identified a loophole in the membership criteria that allowed members to join with only a limited time left on a membership and then not renew at the next billing cycle. This was taken to the executive board at the MWM and the EB approved a resolution to close this loophole. New members who join with less than four months left in the billing cycle must now pay for the remaining billing cycle, plus the next billing cycle dues.

**Promote Membership**

This charge is ongoing. The membership committee is continuously working with staff on ways to promote membership. The member get a member campaign has resulted in an increase of over 180 new members.

**Chapter Requests**

The chapters had requested that the membership committee investigate the possibility of proposing to PDEF a resolution to help offset the cost of bringing in speakers to local/state meetings. Some chapters have no problems with this, but others are continually struggling. The membership committee did investigate this and it was felt that the PDEF would not support this type of request because of the other possibilities for acquiring speakers, such as corporate sponsors.

**Mentoring New Leaders**

This charge is ongoing. Ellie Zimmer has developed a new mentoring program that is geared towards new leaders within the SNMTS as well as can be used at the chapter level. The first letters regarding this program went out to chapter leaders around the first of May this year.

**Awards Ceremony**

The SNMTS leadership and the SNM leadership met to look at combining the awards ceremony. It was felt that the two ceremonies really would not fit because of time constraints at the sessions where awards are given out. The SNMTS then looked at other opportunities as to when to give the awards out. It was worked out with the SNM that the technologist section would give their awards out during the SNMTS Plenary Session. This will give the award recipients more recognition with a larger audience than the SNMTS business meeting.
Additional Goals/Objectives Added for 2007-2008:

No additional goals/objectives have been added to date.
Nominating Committee Report
Committee Charges for 2007-2008:
The Nominating Committee will conduct the annual election process for the SNMTS.

The Nominating Committee will oversee the new online voting process for the current year election and will oversee a complete transition to online-only voting for future years.

The Nominating Committee will review the Election Handbook and provide suggestions to the Policy and Procedures Task Force.

Current Objectives/Goals (please reference Strategic Plan):

- Review candidates for the following open positions: President-Elect, Secretary, Finance Committee (1-year), Finance Committee (3-year), Delegate-at-Large, Vice-Speaker, Member-at-Large, Director-at-Large, Education Specialty Rep, Student Specialty Rep, Cardiology Specialty Rep, Manager Specialty Rep, Industry Specialty Rep, and Emerging Technologies Specialty Rep. – and develop successful slate of candidates. (Infrastructure Issues – Governance – Review and enhance it’s leadership development and succession plan.)

- Hold election for above-mentioned positions. (Infrastructure Issues – Governance – Review and enhance it’s leadership development and succession plan.)

Progress of Charge/Objectives/Goals to Date:
The Nominating Committee successfully held the 2008-2009 National Elections, which closed, May 15, 2008. Scott Holbrook, Chair of the Nominating Committee, notified all the candidates with the results of the election. The NCOR Specialty Area Representative election was held May 5, 2008 through May 27, 2008 - all the candidates were notified of the results of the Specialty Area election by Scott Holbrook. The Nominating Committee met via conference call to discuss the slate for the remaining open positions: Member-at-Large, Director-at-Large and Nominating Committee. The slates have been identified and the individuals contacted. The NCOR will vote on the remaining positions in an on-site election at the Annual Meeting.

Additional Goals/Objectives for 2007-2008:

1. Work with SNMTS Bylaws Committee to ensure Bylaws are followed throughout the election process.

2. Send out RFP to election companies to determine if a new Election Company will be used.
SNM TS
Advancing Molecular Imaging and Therapy

Professional Development Task Force
Program Committee
Committee Charges for 2007-2008:
- Organize the SNMTS scientific and teaching program at the Mid-Winter and Annual Meetings of the Society

Current Working Objectives/Goals
- Goal A: SNMTS will be the indispensable resource in promoting, and educating in knowledge exchange, training, and networking for nuclear medicine, molecular imaging and therapy
- Goal C: SNMTS will be a leader in educational and credentialing/licensing efforts for imaging specialists in nuclear medicine, molecular imaging and therapy

Progress of Charge/Objectives/Goals to Date:
The Program Committee has been very busy in the last few months organizing the information for submission for the SNM Annual Meeting in New Orleans. We have solidified organizers for every CAT and CE Session. This year the following will be offered at the Annual Meeting:

4 Categoricals on Saturday, June 14, 2008
- Clinical Nuclear Medicine
- PET
- CT
- Cardiology

12 CE Session Tracks on Sunday, June 15 – Tuesday June 17, 2008
- Professional and Personal Development
- Cardiovascular
- Clinical Nuclear Medicine
- PET
- Advocacy
- Reimbursement & Coding
- Radiation Safety
- Radiopharmacy
- MRI
- Pediatrics
- Neurology
- EANM

The Educators have an action packed week filled with Mock Exams, student papers, continuing education, and many other exciting offerings. The Plenary Session will focus on how to be an “Emergency Responder”. We will hear a real life account of the Katrina evacuation. Emphasis will be placed on the caregivers’ feelings during a time of tragedy, if preparations for Joint Commission, Fire Safety, Emergency Plans, Evacuation Plans, etc. truly were effective. Part of the honoraria for the Plenary Speaker will be donated to charity on behalf of the speaker and the SNMTS. We are awaiting information on the numbers of abstracts submitted during last week’s deadline. We look forward to a productive winter and spring.

Additional Goals/Objectives Added for 2007-2008
Participate in a Service Project at the SNM Annual Meeting that promotes giving back to our host city, New Orleans and the surrounding community. They are experienced so much devastation since our last meeting in 2003.
Publications Committee
Committee Charges for 2007-2008:
1. Maintaining the high quality of JNMT and supporting the new editor.
2. Keeping the section’s book program active and proactive.
3. Ensuring that the section’s publications support its strategic plan.

Current Working Objectives/Goals (please reference Strategic Plan):
1. Develop and publish educational materials in the JNMT, Uptake and the SNM webpage to assist and inform educators regarding the progress of advanced practice practitioner.
2. Design CE education activities and programs in Emerging Technologies: … (c) Increase content in JNMT supplements.
3. Meet the needs for all relevant audiences in continuing professional development. Goal Year 3: … Launch a series of primers on emerging technologies and molecular imaging and therapy published by the JNMT.

Progress of Charge/Objectives/Goals to Date:
- JNMT statistics are good.
- JNMT has published its first SNM procedure guideline (March 2008 issue).
- Seven CE articles have been published within the past 4 issues (1 year).
- The book on Nuclear Medicine Procedures in Spanish/English, by Juan Mas, was published in two formats: a standard size flip chart and a pocket-size perfect-bound book. It has been selling extremely well: 156 flipcharts and 220 pocket guides have been sold in just 2.5 months.
- The Instrumentation book was halted after a number of rounds of reviews.
- The revision of Nuclear Cardiac Imaging is due in August 2008; the review committee is appointed and ready.
- Six information-packed issues of Uptake have been published in the past year, on time and within budget. In addition, Uptake was redesigned in synch with SNMTS’s new brand.
- Columns and articles have been published frequently in both journals and Uptake about the progress of the advanced practice practitioner initiative.

Additional Goals/Objectives Added for 2007-2008:
- Create a plan of action to reach the goals specified in the strategic plan.
- Investigate new books for the pipeline.
Unfinished Business
New Business
Adjournment