

Nuclear Medicine Residents Training Program Overview

The primary objective of this program is to provide an intensive, integrated, clinically oriented educational experience in nuclear medicine. The program seeks to:

1. Create a learning environment with adequate and appropriate resources for both residents and staff.
2. Familiarize the trainee with the basic principles upon which the field of nuclear medicine is founded including radiation physics, radiobiology, health physics, instrumentation, radiopharmacy, radioimmunology, and computer science.
3. Provide adequate exposure to all areas of clinical nuclear medicine, both diagnostic and therapeutic.
4. Allow gradual assumption of responsibility by the trainees while maintaining adequate supervision hopefully achieving in the trainee both competence and confidence so that upon completion of the program he or she will be able to function effectively as a nuclear medicine physician.
5. Provide an opportunity for clinical and/or basic research especially for individuals considering an academic career.

Meeting these objectives requires adequate staff, equipment and space, sufficient case material, and importantly, a stimulating educational environment.

All primary teaching personnel are full-time members of the academic faculty of Wake Forest University School of Medicine with an active interest in teaching at the resident level. The faculty composition is relatively stable. The major changes in faculty are a new director of the Nuclear Medicine Section, a new director of the Residency Training Program, and a new Radiopharmacy instructor.

The patient volume is adequate for exposure to all areas of clinical nuclear medicine. All nuclear imaging, in vitro studies and therapeutic administrations at the WFU/Baptist Medical Center are performed under the direction of nuclear medicine and all are utilized for resident education. Wide ranges of studies are performed. Especially active areas include skeletal, cardiac, renal, pulmonary, and PET imaging procedures. A relatively large number of hyperthyroid and thyroid cancer patients are seen for treatment and follow-up.

The hospital has provided excellent resources to assist us in accomplishing our objective. Recent additions including two gamma cameras, upgrades for dedicated nuclear medicine computers, a PACs system which provides access to all digital imaging done in the hospital, and an information system, which allows online access to all inpatient and some outpatient records. These hospital wide systems are very helpful in correlating nuclear medicine studies with other clinical and imaging information.

There are two tracts offered subspecialty training in Nuclear Medicine. One is a one-year program that combines training in diagnostic radiology with one year of training in nuclear medicine. The second is a two-year program in nuclear medicine, which is offered to physicians who are board eligible in any medical specialty.

The two-year nuclear medicine residency is organized to provide in depth training in clinical and investigative nuclear medicine. Applicants are taken outside of the match and are chosen on the basis of their prior experience and interest in pursuing a career, which though it may not be confined to nuclear medicine will consist in large part in the practice of nuclear medicine.

The first year emphasizes the core material, which provides the basis for the practice of clinical nuclear medicine, through lectures and conferences as described below.

Radiology/Nuclear Medicine Core Curriculum Lecture Series. This didactic curriculum is presented in a series of daily lectures (7:30 AM Mon-Fri except Wed) presented by the entire faculty of the Department of Radiology including the nuclear medicine faculty. This lecture series covers not only a discussion of the performance and interpretation of diagnostic imaging but also pertinent pathologic and patho-physiologic bases underlying the studies. Correlation with findings on other imaging modalities is also included. During the two-year cycle approximately 25 hours are devoted specifically to nuclear medicine topics. Nuclear medicine procedures may be covered in other lectures as well when multimodality correlation is discussed. These lectures are especially useful to non-radiologist training in nuclear medicine because it gives them a good background for correlation of nuclear medicine studies with other imaging modalities.

Interesting/Proven Case Conference. This is a daily conference, which is held from 12:30-1:30 p.m. Here residents are presented with unknown cases and are asked to discuss the pertinent findings. All sections in radiology participate and multimodalities are shown in most conferences. Every other Friday the conference emphasizes nuclear medicine. The nuclear medicine residents are primarily responsible for organizing this conference with the assistance of other radiology residents rotating on nuclear medicine at the time. The residents present the cases to their peers and quiz them on technical aspects of performing the studies as well as interpretation, differential diagnosis and further work up. After the cases are discussed as an unknown, the nuclear medicine resident reviews the pertinent teaching points for which the case was chosen. The role of the faculty in this conference is to act as a reference to answer questions which the nuclear medicine resident cannot. Residents attend this conference both years. Approximately 32 conferences will be devoted to nuclear medicine.

Basic Science Seminar Series. This is a 1 ½ hour session presented weekly to the residents assigned to nuclear medicine by the basic science faculty. It emphasizes instrumentation, computer science and radiopharmacy. Occasionally topics related to radiation protection are included. The series includes lectures, discussion, and

laboratory demonstrations. These conferences are repeated every eight weeks. The nuclear medicine resident attends two cycles each year for a total of 48 hours.

The Clinical Review Conference. This is a 1-1 ½ hour session presented weekly to the residents usually at 7:30-8:30 AM Wednesday. This conference is organized around organ systems and covers both imaging and non-imaging diagnostic techniques as well as therapy. The format is usually socratic with intensive questioning of the residents on technical aspects of performing the studies (radiopharmaceuticals, dose, patient preparation, imaging protocols, etc) as well as imaging interpretation and clinical correlation. An extensive file of cases is maintained specifically for this conference. This collection is separate from other teaching files. This conference is on an 8-week cycle. During the two years of training, residents would participate in approximately 100 hours.

The Physics/Radiobiology Course. It replaces the Core Curriculum in the summer. It is a daily lecture series lasting about 1-1 ½ hours. It covers radiobiology, nuclear physics, statistics and mathematics of radiation protection. While the radiology residents attend all of these sessions, the nuclear medicine residents attend those sessions specifically related to nuclear medicine (45 hours).

The Journal Club meets monthly and is devoted exclusively to discussion of nuclear medicine articles. Papers are presented by each of the residents (usually clinical or clinical research oriented articles) and selected faculty (clinical or basic science articles) depending on their expertise.

The residents are encouraged to attend interdepartmental conferences such as endocrinology, cardiology, oncology, epilepsy (EMU) and medical and surgical grand rounds when pertinent topics are presented.

In addition to the lecture and conferences listed above, the residents work in the general nuclear medicine and PET clinical areas acting as "senior" residents and functioning as consultants to "junior" residents. While in the general clinical area, diagnosis and therapy of thyroid disease as well as cardiac imaging are emphasized while in PET; FDG imaging in Oncology is emphasized with some studies of myocardial and cerebral glucose metabolism.

Specific blocks of time are dedicated to:

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| 1. | Radiopharmacy/Radiation Safety | 2 weeks |
| 2. | Instrumentation/Computer Science | |
| | Single photon | 2 weeks |
| | PET | 2 weeks |
| 3. | Nonimaging lab procedures | 1 week |
| 4. | Cardiac stress lab | 4 weeks |
| 5. | Procedure technology | 2 weeks |
| | (works with technologist in each area) | |

Other duties and responsibilities begun during the first year include participation in the Quality Improvement Committee, Instruction of medical students and participation in the nuclear medicine call schedule (one week out of three) with faculty back up.

The second year builds on the foundation laid during the first year with continual reinforcement of the core material learned the first year and attention to the less frequently utilized nuclear medicine procedures. Other duties started during the first year are assumed with greater responsibility. They include:

- a. Participation in the sections Quality Improvement Committee. While the residents reviewed protocols and suggested improvements during the first year under the direction of a faculty member, they are expected to do that on their own during the second year.
- b. In addition, residents are given the opportunity to prepare and deliver formal lectures to nuclear medicine technologists, medical students and other house officers.
- c. A second research project should be accomplished during the second year. This can be either an extension of the previous year's project with a new or expanded focus, or an entirely new project. Either way it should be the resident's project with little direction from the faculty.
- d. Attendance at interdepartmental conferences should be more frequent during the second year of residency. The second year resident may act as the section's representative at those conferences.

The following educational facilities are available to the residents throughout their training.

- a. Audiovisual Lecture Series. This consists of a series of tape lectures prepared by the faculty and available for independent review. These cover most common Nuclear Medicine procedures and encompass approximately 44 hours.
- b. The Nuclear medicine Computerized Teaching File. This was developed "in-house" by Dr. Cowan and is maintained in the Nuclear Medicine area. Both dynamic and static images are available including SPECT and 3-D volume preprojections. This is one of the most popular educational tools.
- c. Departmental Teaching File. This collection of cases on all radiologic modalities including nuclear medicine is maintained in the general departmental and learning center.
- d. Sectional/Department Library Facilities. There is an extensive collection of textbooks, monographs, and journals in the Nuclear Medicine Conference Room. This is supplemented by additional nuclear medicine material in the main departmental library. Internet access to online teaching files from other institutions is also available in the nuclear medicine conference room.

National Meeting Attendance. Residents are provided financial support for the cost of one educational meeting annually. Residents who present papers receive additional support.

Residents initially rotating on Nuclear Medicine are allowed an orientation period to become more familiar with the clinical problems. Residents on the service function as a team with senior residents providing guidance and assistance to the beginning residents. Faculty supervision is always available. During these initial rotations, introductory discussions are provided on radiopharmacy, instrumentation, and all common clinical procedures.

As the resident gains familiarity with the usual techniques, he or she assumes more independent responsibility for handling patient studies. Residents begin to participate in conference preparation and teaching file preparation. They provide preliminary reports on stat procedures and work closely with the staff technologists in tailoring procedures to the individual needs of patient problems.

Upon completion of the initial three-month rotation, residents begin providing emergency on-call coverage for Nuclear medicine, approximately one week out of three. This call schedule continues throughout the residents training period. Also, after their initial three months, they are expected to function more as a consultant to the other house officers, to assist in the work-up and admission of patients on the inpatient Nuclear Medicine service, to supervise rotating diagnostic residents, and to assume more responsibility for conference presentation and preparation.

They participate in quality assurance activities and are responsible for protocol reviews at the bimonthly QA meetings. They function as back-up on-call support for the third-year resident covering Nuclear Medicine and provide physician coverage in the Nuclear Medicine clinic during Saturday mornings in rotation with the faculty.

At least one attending physician is present during the normal operating hours in the clinical area for resident supervision and consultation. All studies interpreted during this period are read in conjunction with attending and the final report generated by the resident, is reviewed and approved by the attending physician before dictation. Emergency after-hour procedures are initially interpreted by the Radiology resident on call for Nuclear Medicine. On the weeks when the nuclear medicine resident is on call, he/she serves as back up to the radiology resident for consultation, advice or assistance in difficulty cases. An attending is available by beeper if needed. On-call studies are reviewed by the attending physician the following morning and any corrections are discussed with the resident and the ordering service.

All the nuclear medicine training is conducted at the Wake Forest University/North Carolina Baptist Hospital Medical Center. Some nuclear medicine studies performed at outside hospitals are read a priori in this department or reviewed in this department. Residents are also encouraged to moonlight in area hospitals in order to maintain their proficiency in other imaging or clinical areas but this is not part of the formal residency training.

Pediatric patients account for approximately 10% of the total hospital admissions and approximately 10% of the nuclear medicine studies. We do nuclear medicine studies on approximately 470 pediatric patients annually so that over the entire training program, the Nuclear Medicine resident would be exposed to more than 700 pediatric examinations.

Pediatric urological procedures represent the most common study due to an extremely active pediatric urologic clinic. A wide variety of pediatric patients, including pediatric oncology provide a full spectrum of pediatric cases.

During lectures and conferences throughout the training program, pediatric applications are presented in conjunction with organ-oriented topics. In addition to the time spent in Nuclear Medicine, residents attend formal lectures and informal case presentations given by the Pediatric Radiology section. These sessions emphasize correlation of multiple imaging modalities in the pediatric patients.

The Nuclear Medicine Section participates in all quality assurance activities of the Department of Radiology. In addition, quality assurance issues are specifically discussed at a bi-month sectional meeting in Nuclear Medicine attended by faculty, selected technologist staff, and residents during both years of training. Selected monitors are reviewed at these meetings and appropriate actions taken. Examples of recent projects include: patient satisfaction evaluation, completeness of inpatient hospital records, review of radiation exposure of occupational personnel, accuracy of resident interpretation of "on call" studies, review of misadministrations/incidents, and systematic review and updating of protocol manual. Residents assist in data collection and participate in discussion and decisions. At each session, the resident has the primary responsibility for systematic updating of the procedure protocol manual through a series of reviews and presentations to the entire group usually working with Dr. James Ball during the first year and on his/her own the second year.

Resident participation in all conferences is expected and required. Residents are freed from clinical responsibility on Nuclear Medicine during conference and lecture presentations with clinical coverage being provided by appropriate faculty. While many of the conferences are didactic presentations by faculty, at some of the conferences and seminars, residents are called upon for oral discussions. Residents do have a primary responsibility for the presentation of the following conferences:

1. Nuclear Medicine Proven Case Conference
2. Journal Club

Due to the relatively small size of the program, written attendance at lectures is not formally documented, but the faculty is well aware of absence of Nuclear Medicine residents and appropriate action is taken if necessary. Logs are kept of resident attendance at the Clinical Review Seminars and of cases presented by residents at the Interesting Case Conference.

The clinical imaging facility in the Nuclear Medicine Section is available for investigative protocol studies in both hospitalized and outpatients.

An additional research lab measuring 23 by 14 feet is also available. It has a large area of counter space and extensive storage space for equipment and reagents. It has a sink and multiple outlets as well as a ventilated hood and a sink with natural gas outlets.

The PET Center contains approximately 12,000 square feet of space. This includes:

1. Cyclotron: Siemens/CTI RDS 112, 11 MeV negative ion cyclotron and radiopharmaceutical production and delivery system.
2. Radiochemistry lab: Facilities for both high and low level radioactivity radiopharmaceutical production and research including two hot cells, four mini shielded cells, and four shielded fume hoods. A separate area contains three unshielded fume hoods and a laminar flow sterile hood for non-radioactive processing and chemistry.
3. Organic Chemistry lab: Includes three fume hoods and analytical instruments for radiopharmaceutical research and development including FTIR, HPLC, GLC, and TLC scanner.
4. PET scanner: GE Advance PET Scanner.
5. Image interpretation room: There are multiple updated Sun SPARK 5 review stations for processing and review of studies as well as stations for programming.

The Bowman Gray School of Medicine animal facility is staffed by trained veterinarians and has special areas for the housing of animals containing radioactive material. The Medical Center provides a biostatistician for assistance in data analysis and paper preparation. The departmental and Medical Center libraries provide assistance in computerized index searching and biographical verification. The Audiovisual Center is available for assistance in illustration preparation.

The resident's workday begins at 7:30 AM each weekday morning for the initial core lecture presentation. They are expected to be present in the clinical area until at least 5:00 PM daily during the week. Depending on the clinical demands at that time, residents may work beyond the 5:00 PM completing interpretation of the day's work. It is rare that this would require presence beyond 6:00 PM, however. Also on occasion, visiting professor lectures are held in the evening and they would be expected to attend these as well.

During both years of training, the nuclear medicine residents are on call one week at a time, approximately one week out of three to provide back-up coverage for the third year Radiology resident. Call is taken from home and beepers are supplied. Faculty supervision is available for the nuclear medicine resident. In addition to providing back-up call for night time procedures, the nuclear medicine resident on call would also handle Saturday or Sunday day time procedures that might be required, again with faculty back-up. All emergency studies are reviewed by faculty prior to final distribution of the report.

Residents are evaluated at the end of each quarter by a formal written evaluation filled out by all clinical faculty involved in resident education. These evaluation forms are reviewed with the resident. If any concerns or deficiencies are noted, these are discussed personally by the Program Director with the resident.

A copy of these evaluations is maintained in the resident file. These evaluations are based on personal observations by the faculty in their daily work with the residents, on the performance of residents during the seminar and conference questioning sessions and on an annual ABNM inservice training examination.

The educational experience provided by each section of the Radiology Department is also evaluated by each resident quarterly. These are reviewed by the Chairman of the Department of Radiology and suggestions, compliments, or criticisms are related to appropriate faculty/service, especially the Program Director. Faculty members are evaluated annually by the residents in a questionnaire from the Chairman of the Department of Radiology. The Chairman discusses areas of concern with the individual faculty members.

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