

Personalized Growth and Development Plans for Young Nuclear Medicine Physicians

TO THE EDITOR:

We read with interest the commentary by Harolds et al. (1) describing the current nuclear medicine job market in the United States, with a root cause analysis and possible solutions mainly from the educator's perspective. The purpose of this commentary is to provide young nuclear medicine physicians advice on the various options available that will help them prepare for the next logical step in their development.

We have recently switched from a 2-y (PGY-2 and -3) nuclear medicine curriculum to a 3-y (PGY-2, -3, and -4) program in the United States. In the European Union (EU), the minimum duration of specialized nuclear medicine training is 4 y but may be extended beyond this period according to the requirements of training in other allied disciplines (for example, radiology). The European Association of Nuclear Medicine (EANM) and European Society of Radiology (ESR) have created a Joint Working Group with the aim of developing an interdisciplinary training program and establishing a certification in what they call hybrid imaging. This innovative initiative would require training in 1 of the 2 specialties (nuclear medicine and radiology), followed by specific training in hybrid imaging, extending the total duration of training to a minimum of 6 y (2,3).

At the present time, as many of our trainees successfully prepare to advance their careers, an ever-increasing variety of options is available for recent graduates of nuclear medicine training programs. We remember the time in the late 1990s and early 2000s when jobs in nuclear medicine were few and far between and the mere thought of where to begin securing a nuclear medicine position was the cause of much apprehension. Although more diverse opportunities for an imaging physician are available in today's world, many trainees are experiencing limited job prospects.

Several options are available for our young colleagues, and these may be divided into 2 main groups: additional training or independent practice. Additional training may be obtained in a radiology residency, clinical nuclear medicine fellowship, PET fellowship, or research fellowship. Independent practice options include clinical nuclear medicine academic or private practice options, academic research in clinical or small animal imaging, or employment with industry. We will tailor our advice to each of these options, along with some guiding principles.

Our first advice would be for the young physician to be honest with him- or herself. Those who genuinely feel ready to fulfill duties as an unsupervised practicing physician and

follow the guiding principles of the Hippocratic Oath ("first, do no harm") should do so. Our second suggestion would be to follow one's heart. Some young physicians have dreamed of learning about other anatomical imaging modalities, and we would encourage these perennial students to pursue their dreams. Our third recommendation would be to be confident in one's ability to meet specific educational and personal goals ("if it is to be, it is up to me").

Additional Training

Additional training options include radiology residency, clinical nuclear medicine fellowship, PET fellowship, or research fellowship. Radiology residency may be contemplated by those who plan to learn more about cross-sectional imaging, would like to explore other imaging modalities, or are attracted by the draw of supplementing their marketability and compensation potential. Indeed, radiology has been "hot" for the past decade in terms of recent technological advancements, compensation and profitability, and increasing demand and availability of lucrative practice options. However, the changing marketplace is having a cooling effect on the specialty. Although demand for radiology is still present, a recent flattening has been noted in relative value units, compensation, and availability of jobs.

Fellowships in clinical nuclear medicine or clinical PET are popular for trainees who hope to hone their skills. Recently an increasing number of U.S. clinical fellowships are being offered to radiologists rather than nuclear medicine physicians. U.S. fellowships are also open to EU and other foreign-trained imaging physicians and are a challenging experience for overseas trainees who might not be adept in the English language or familiar with U.S. medical practice. Hybrid imaging training, as mentioned earlier, seems to be the future in both the EU and the United States, opening up a wealth of clinical job opportunities.

In addition, several options are available for research-based fellowships in small animal or molecular imaging research (for example, the Molecular Imaging: Training for Oncology R25T program sponsored by the National Institutes of Health at selected academic institutions and fellowships offered by the Medical Research Council in the United Kingdom).

Independent Practice

Independent practice options encompass academic, community hospital, or private practice clinical nuclear medicine positions, as well as positions in research and with industry. Academic attending positions usually mandate a research

component in clinical or small animal imaging. In general, there is a paucity of attending clinical and research opportunities at the moment. Most clinical academic centers are increasingly looking for dual-certified applicants, which has been true for the vast majority of private practice settings in recent years. In addition, an increasing number of academic centers are expressing a desire for their current nuclear medicine-trained faculty to procure grants as well as to be productive in research and publications.

In the clinical setting, requirements for board certification vary. Not all hospitals require board certification, and some require board certification a few years into the appointment. In the United States, 3 main accrediting bodies exist for medical specialties: the American Board of Physician Specialties, the American Board of Medical Specialties (ABMS), and the American Osteopathic Association's Bureau of Specialists. The American Board of Nuclear Medicine (ABNM), a member board of the ABMS, is the primary certifying organization for nuclear medicine physicians in the United States. Other certifications of added value for which nuclear medicine physicians are eligible include those of the Certification Board of Nuclear Cardiology and the Certification Board of Cardiovascular Computed Tomography, as well as the Cardiac CT Certificate of Advanced Proficiency. The boards governing these certifications are not member boards of the ABMS (4). Although board certification is a voluntary process, more than 80% of physicians in the United States are board certified. Board certification means that the physician's skill and knowledge in the specialty/subspecialty have been examined and tested and meet the standardized requirements of an ABMS member board. A physician is licensed by the state to "practice medicine and surgery," and board certification is usually not a requirement for licensure. A licensed physician may practice in whatever area of medical interest he or she chooses and can legally practice in that field without completing a residency or fellowship. As a result, some out-of-work nuclear medicine physicians have recently reached out to work with general practitioners or in emergency room settings.

The EANM offers a certificate of fellowship from the European Board of Nuclear Medicine. This certificate in nuclear medicine establishes that the candidate's knowledge and ability in nuclear medicine satisfy European standards. The European quality recognition is optional and does not interfere with national requirements for specialization in nuclear medicine (5).

In the research arena, some common themes arise. The first is PET and, especially, the use of PET/CT for merging function with structure for diagnosis and integration into patient care. A second theme comprises development of molecular radiotherapy approaches and demonstration of their therapeutic efficacy. A third theme comprises molecular imaging, with its use of nuclear medicine-specific methodologies for delineating disease mechanisms and for guiding gene-, molecule-, and cell-based therapies.

The overarching goal might be the merger of these research themes into a patient-specific approach to diagnosis and treatment, with potentially profound effects on the future practice of medicine.

One of the less orthodox (although increasingly viable) opportunities would be to seek to practice in a nontraditional setting. Recent advances in recognition of the role of imaging biomarkers in drug development have afforded various positions in industry. A variety of imaging physician or imaging project leader positions are available in biotech companies, pharmaceutical companies, and contract research organizations. In addition, clinical project leader positions are available in tracer development in industry. To further explore these principles and techniques of molecular imaging, SNM's Center for Molecular Imaging Innovation and Translation is actively engaged in the design of educational programs (6).

The current economic climate and push to reform health care have led to declining compensation in recent years, reflecting the negative influence of decreased reimbursements, field saturation, turf battles, the cost of obtaining and maintaining new technology, and other factors impacting practice revenues. These factors have contributed to a lack of available positions. The vast majority of qualified nuclear medicine physicians still choose to practice in clinical nuclear medicine settings. A select few have been successful in nontraditional practice settings, and opportunities are increasing for physicians to work in industry, particularly if they have demonstrated keen interest during their training or subsequent practice.

The growing recognition of *The Journal of Nuclear Medicine (JNM)* has been especially rewarding. The science edition of the Thomson ISI *Journal Citation Reports* for 2009 listed an impact factor of 6.424 for *JNM*, so it currently ranks first among all journals on radiology, nuclear medicine, or medical imaging. Major developments, challenges to established views, and innovations deserve emphasis and thoughtful analysis. *JNM* provides a means to this end. One means is the publication of "Invited Perspectives," in which leading experts examine the significance and implications of new contributions and the ways these might influence our field. Another means is the publication of supplements intended to highlight specific areas of development in nuclear medicine and to serve as an educational resource (7).

The *European Journal of Nuclear Medicine and Molecular Imaging (EJNMMI)* also is recognized as a premier publication and has consistently maintained a high impact factor, currently 4.531 (8). EANM has provided educational courses since 2003, starting off with PET and increasing progressively in topics and languages. *JNM* and *EJNM* also serve as forums for scientific exchange and discussion.

The directions that nuclear medicine practice is likely to take in the next decade are promising in both the United States and Europe. We hope that this communication will

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higher than that of ^{18}F -FDG. All non-neoplastic lesions showed decreased ^{13}N - NH_3 uptake. The authors concluded that “the preliminary results of this study suggest that ^{13}N - NH_3 PET may be helpful to detect and differentiate brain tumors which show hypometabolism on ^{18}F -FDG PET from nonneoplastic lesions with high specificity, especially for cerebral astrocytomas, but the sensitivity is relatively limited.”

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Sex Differences in Cardiac Hypertrophy

Foryst-Ludwig et al. from the Charité Universitätsmedizin (Berlin, Germany) reported ahead of print on April 8 in the *American Journal of Physiology. Heart and Circulatory Physiology* on a study exploring the reasons for sex-specific differences in exercise-induced cardiac hypertrophy. The authors looked at whether previously reported sex-dependent differences in cardiac hypertrophic response during exercise are associated with cardiac energy substrate availability/utilization. The study was conducted in female and male mice challenged daily with active treadmill running for 1.5 h/d for 4 wk. Mice underwent cardiac and metabolic analyses, includ-

ing echocardiography, small-animal PET imaging, periexercise indirect calorimetry, analysis of adipose tissue lipolysis, and cardiac gene expression. Female mice showed greater cardiac hypertrophic responses to exercise than male mice, as measured by echocardiography. This was found to be associated with increased plasma free fatty acid levels and augmented adipose tissue lipolysis in females after training. The respiratory quotient during exercise was found to be significantly lower in females. Cardiac genes involved in fatty acid uptake/oxidation were increased in females. The authors concluded that, collectively, these data demonstrate that “sex differences in exercise-induced cardiac hypertrophy are associated with changes in cardiac substrate availability and utilization.”

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REVIEWS

Review articles provide an important way to stay up to date on the latest topics and approaches by providing valuable summaries of pertinent literature. The Newline editor recommends several reviews accessioned

into the PubMed database in April. In an article e-published in the April 1 issue of *Current Pharmaceutical Biotechnology* (2011;12:508–527), Sekar et al. from Stanford University (Palo Alto, CA) provided an overview of “Imaging cellular receptors in breast cancer.” Coles and Li, from the Emory University School of Medicine (Atlanta, GA) reviewed “Functional neuroimaging in the examination of effects of prenatal alcohol exposure” on April 12 ahead of print in the *Neuropsychology Review*. A meta-regression analysis of “Stem cell tracking in human trials” was presented by McColgan et al. from Imperial College Hospitals (London, UK) on April 8 ahead of print in *Stem Cell Reviews*. Santra and Malhotra, from the University of Central Florida (Orlando) reported on April 8 ahead of print in *Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology* on “Fluorescent nanoparticle probes for imaging of cancer.” In a 3-part series published in the April issue of *Health Physics* (2011;100:359–416), Watson and Strom, from the Pacific Northwest National Laboratory (Richland, WA), reported on “Radiation doses to members of the U.S. population from ubiquitous radionuclides in the body.”

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provide some guidance and will help our young nuclear medicine physician trainees transition to the next step in their careers.

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