Jobs and New Initiatives in Nuclear Medicine Education

A growing number of nuclear medicine physicians who are not radiologists are unable to secure employment after completing their residency training. A recent Internet posting stated that none of the 4 graduates from a prestigious university nuclear medicine program was able to find a job. Another highly regarded nuclear medicine residency program will soon close because the program director cannot justify training physicians given the limited job market.

Over the last several years, this situation has worsened. In 2006, a small survey concluded that approximately 20%–28% of recent nonradiologist nuclear medicine graduates were unemployed (*1*). In 2010, SNM created a Jobs Task Force to address the impact of the weak job market on the viability of nuclear medicine as a specialty for training nonradiologists in isotopic medicine. Many thoughtful discussions centered on multiple contributing factors. The task force explored potential solutions and inventive scenarios. One of their first actions was to survey the recent nuclear medicine graduate community to assess objectively the current depth of this problem.

On March 17, 2010, a job survey was distributed to 214 nuclear medicine physicians who had become certified by the American Board of Nuclear Medicine (ABNM) during the past 3 y. Forty-nine (23%) complete responses were received by May 17, 2010. The survey questions and response summary are given in Table 1.

The survey revealed the following employment status for these recently board-certified nuclear medicine physicians, approximately 25% of whom were also certified by the American Board of Radiology (ABR):

- 51% employed primarily in nuclear medicine;
- 20% employed in another residency training program, including radiology;
- 14% employed in medicine but not in nuclear medicine;
- 4% employed but not in medicine; and
- 8% not employed.

Two-thirds had secured an employment opportunity before completing training; however, 18% of these declared that they had been unable to find a nuclear medicine job. The majority (57%) of respondents were international medical graduates.

With such limited availability for nuclear medicine positions, it is not surprising that 3 respondents submitted these revealing free-form comments:

- "I am very frustrated right now. Nuclear medicine jobs are divided between cardiologists and radiologists. . . ."
- "I am in the U.S. Army. Anyone willing to repeatedly leave [his/her] family for a year at a time to go to war in a God-forsaken desert could have a secure nonradiologist nuclear medicine job, too."
- "Almost all of my friends, around 10, are doing their second residency. Nuclear medicine residency is [a] dead end under [the] current job market and I do not think program directors or SNM inform prospective candidates accordingly."

The Job Market: Problem and Root Cause Analysis

What are the possible factors contributing to limited employment opportunities for nuclear medicine physicians who are not radiologists? Considering that approximately 16 million nuclear medicine procedures are performed annually in the United States (*2*) *and* that there are fewer than 90 new ABNM diplomates each year, one would surmise that the job market would be strong. On the contrary, many extrinsic and intrinsic factors likely contribute to the weak job market for nonradiologists.

(1) Socioeconomic Factors

Economics. In response to the contemporary economic downturn, hospitals, clinics, and group practices tend to tighten their budgets, curtailing or jettisoning their least productive components, including expensive physicians. It is sound business reasoning that a physician who is perceived as having greater productivity and "revenue generating" potential would be more highly valued by the organization. One such physician is a radiologist, who is capable of interpreting examinations using multiple modalities rather than nuclear medicine studies alone. Thus, it is not surprising that nonradiology nuclear medicine physicians are frequently supplanted by radiologists "who can do nucs," or, alternatively, accept reduced salaries as a reflection of their perceived relatively decreased value. An Internet Web site on "How to Get Nuclear Medicine Physician Jobs" captured this perspective accurately: "Getting the Job: Nuclear medicine is often considered a more specialized version of diagnostic radiology. Openings strictly for nuclear medicine physicians are scarce, so it is a good idea to have skills in diagnostic radiology as well" (*3*).

Other economic factors that may be exacerbating this job shortage are the declining stock market and housing devaluations, not to mention declining reimbursement, epitomized by Medicare cuts and recent health care legislation. In recent years, many physicians have experienced a marked decrease in net worth. Therefore, it is not uncommon that some nuclear medicine physicians are delaying retirement. Moreover, some imaging groups and medical institutions are reluctant to hire new physicians because of declining reimbursement,

TABLE 1 SNM Jobs Task Force Survey Questionnaire and Response Summary

Question 1: I am board certified in the following specialty(ies):	
Nuclear medicine (ABNM)	100%
Radiology (ABR)	24.49%
Internal medicine (ABIM)	4.08%
Radiation oncology (ABRO)	0
I have completed nuclear medicine training but am not board certified	0
Other	6.12%
Question 2: I have been board certified in nuclear medicine for:	
Not certified	0
<1 year	28.57%
1–2 years	30.6%
2–5 years	40.82%
5–10 years	0
>10 years	0
Question 3: I completed my nuclear medicine training:	
<1 year ago	30.6%
1–2 years ago	16.33%
2–5 years ago	44.90%
>5 years ago	8.16%
Question 4: I am an American medical school graduate:	
Yes	42.8%
No	57.14%
Question 5: I have the following additional qualifications:	
PhD (in biomedical physics or other research field)	16.33%
Completed radiology training in a foreign country	6.12%
Other	30.61%
Question 6: Please choose one that applies to you:	
I started in a nuclear medicine residency program but later transferred to a radiology residency program	10.2%
I completed a nuclear medicine residency program and then entered a radiology residency program	12.24%
Neither	77.55%
Question 7: I had a job arranged:	
Before completing my training	63.27%
In less than 2 months after training	2.04%
Within 2–6 months after training	8.16%
Within 6 months–1 year after training	4.08%
I was unable to find a nuclear medicine job	18.37%
Question 8: My current job status is:	
Employed doing primarily nuclear medicine	51.02%
Employed in medicine but not nuclear medicine	14.29%
Employed in a nonmedical position	4.08%
Doing another residency (like radiology)	20.14%
I am unemployed	8.16%
Question 9: Any additional comments:	

uncertainty surrounding the inevitable added costs of health care reforms, and the potential for higher taxes on personal incomes and business revenues.

Unstable Molybdenum Supply. The recent shortages and uncertain future supply of ^{99}Mo constitute another potential factor contributing to this job market. In May 2009, the Canadian reactor at Chalk River (Ontario, Canada) was shut down for a major repair. This reactor supplies 50% of the world's ^{99}Mo, and its shutdown resulted in a worldwide shortage of ^{99m}Tc, the "workhorse" of nuclear medicine. With limited global availability of ^{99}Mo, fewer nuclear medicine procedures could be performed. This translated into decreased nuclear medicine–generated technical and professional revenues for imaging facilities and nuclear medicine physicians. With increasing overhead expenses, ongoing concern for future ^{99}Mo shortages, and decreased revenue from unreliable volumes of nuclear medicine procedures, gradual reductions have been made in nuclear medicine staffing (technologists and physicians) and resources (γ cameras, additions, and replacements).

(2) Practice Patterns

Preference for Radiologists over Nuclear Medicine Physicians. A major factor adversely influencing the job market for nonradiologist nuclear medicine physicians is that many private and increasing numbers of academic radiology practices prefer to employ radiologists with (or without) expertise in nuclear medicine. Because diagnostic radiology residency programs must incorporate nuclear medicine into their educational curricula and training programs, radiologists in practice are routinely expected to become credentialed to interpret nuclear medicine studies, including PET/CT scans, under the auspices of his/her own or a colleague's authorized user status.

Radiologists have greater revenue-generating potential than their nuclear medicine counterparts. They can offer greater practice flexibility by providing coverage on other clinical services in addition to nuclear medicine during the typical workday, as well as during the off hours, especially on weekends and while on call (*4,5*). These advantages, however, may be less important in some large subspecialty private and academic practices in which larger numbers of individuals in the practice may make scheduling easier and in which subspecialty expertise may be more valued. However, any job satisfaction in such practices may be compromised for nonradiologist nuclear medicine physicians by reduced salaries and job security threatened by the potential for replacement by radiologists who are capable and willing to interpret nuclear medicine studies and/or perform radioiodine therapy. Nevertheless, larger academic practices generally continue to value the nuclear medicine physician, particularly for his/her teaching abilities and research skills in nuclear medicine and molecular imaging.

To compound this reality, radiologists are sufficiently confident about their nuclear medicine interpretive skills that few seek advanced nuclear medicine training. A survey of senior radiology residents (*6*) provided the following perspectives:

- Nearly 75% felt competent to interpret PET/CT studies;
- 67% believed they could interpret nuclear medicine studies appropriately;

- 33% believed they had sufficient training and experience to administer therapeutic ^{131}I-sodium iodide in activities ≤1.22 GBq (33 mCi); and
- 8% intended to complete a nuclear medicine fellowship.

Of course, individual practices and hospitals have credentialing committees who have the authority to grant or deny clinical privileges. Peer-review programs help to ensure a level of practitioner competence.

Fusion Imaging and Hybrid Technologies. Not all nuclear medicine physicians are expert in interpreting CT scans in some regions of the body, and, as a result, these physicians require a radiologist's help in the interpretation of some or all PET/CT and SPECT/CT studies, especially if independent, primary interpretation of the CT component is required. Some radiologists believe that a complete imaging consultant needs to have expertise in multimodality imaging, including complex hybrid or fusion technologies. This skill set is increasingly expected for integrated multidisciplinary care.

Somewhat paradoxically coincident with revision of Nuclear Regulatory Commission (NRC) training requirements to include fewer hours of training, multimodality fusion imaging has evolved rapidly as PET/CT and SPECT/CT systems have become more widely available. With reimbursement for PET/CT scans now the norm, there has been considerable growth in these hybrid techniques, particularly in PET/CT (*7*), with SPECT/CT and PET/MR imaging emerging as potential powerhouses of future hybrid imaging. Some predict hybrid imaging to become the new standard of care (*8–10*).

Quality Practice Standards. Unfortunately, other employment issues face both nonradiologists and radiologists who have advanced training in nuclear medicine. Self-referral for nuclear medicine imaging by physicians trained in nonimaging medical subspecialties, such as cardiology, is one such obstacle to radiologists and nuclear medicine physicians who are competing for jobs. Allowing individuals who are not well trained in nuclear medicine to interpret advanced nuclear medicine studies creates not only a quality concern but also an employment issue. Furthermore, if the studies are not properly interpreted and reported and/or offer little relevant clinical value to the referring physician, then fewer studies will be ordered, thereby decreasing the clinical case volume.

To that very point, an analysis of questionnaires and imaging reports submitted to the National Oncologic PET Registry found that many of the reports did not contain those elements considered to be essential according to published guidelines from our professional societies (*11–13*). Note that the study did not distinguish among interpreting physicians' training or specialty. As a corollary, it has been suggested that more focused and better designed "pay for performance" initiatives might help raise the quality of nuclear medicine practice by all participants (*12*).

(3) Education and Training

Nuclear Medicine Education and Training: Quantity and Quality. The deteriorating job market for recent nuclear medicine graduates undoubtedly contributes to the increasing difficulty in attracting qualified physicians into the field. As the pool of applicants shrinks, their quality declines at least proportionally. Recently, several nuclear medicine residency programs have not filled. This trend has significant ramifications as to how many programs will/should remain open and raises concerns about the quality of the active programs.

Nuclear medicine is the third smallest accredited residency program in the country. In 2001–2002, there were 67 nuclear medicine residency programs. In 2010–2011, this number has dropped by almost 20% to 54, with a total of 158 residents. Most of these programs are small, with 24 of 54 (44%) programs having only 1 or 2 residents. In addition, there are 21 nuclear radiology fellowship programs with 10 fellows enrolled. Graham (*14*) has pointed out that if one extrapolates the declining trendline for the number of nuclear medicine residency programs from 1993, no residency program will remain by 2035. Most of the programs that have closed over the past decade have been small programs, and the number of graduates taking the ABNM examination has not decreased significantly. Thus the extrapolation is unlikely to be an accurate prediction. However, if more programs continue to close, then ultimately there will be fewer nuclear medicine physicians, and the quantity and quality of teaching and research, as well as clinical practice in nuclear medicine, will undoubtedly suffer concomitantly. The consequences could be even more far reaching, with paralyzed development of new applications of established studies and stymied emergence of new techniques for isotopic and molecular imaging.

Nuclear Medicine Training: Current Changes. The American College of Radiology (ACR) Guideline for Performing and Interpreting Diagnostic Computed Tomography (*15*) requires that nonradiologists participate in the supervised interpretation of 500 CT scans during a 36-mo period, whereas a typical radiology resident would interpret and report several times as many during residency. Many leaders in nuclear medicine recognize the importance of more training in CT for their residents. Before July 2007, no CT training was required in nuclear medicine residency programs. Currently, the Accreditation Council for Graduate Medical Education (ACGME) requires that nuclear medicine residents have at least 4 mo of CT training. Although this requirement can be met by rotations during which interpretations of only PET/CT and SPECT/CT are performed, experience on a dedicated CT rotation is considered optimal to meet this training requirement. Starting in July 2011, the ACGME will require at least 6 mo of CT experience, of which 4 mo must be obtained on a dedicated radiology CT service, although supervised interpretation is not mandated.

One controversial idea is to have an examination to assess the competence of nuclear medicine physicians in

CT interpretation. The exact duration of education and training to achieve competence varies among trainees and programs. Certainly, one can argue that more complex hybrid imaging requires more time and effort to master.

Diagnostic Radiology Education and Training: Recent Changes. Effective July 2010, the ACGME modified the Diagnostic Radiology training requirements to allow up to 16 mo in a single radiology subspecialty during the 4-y program (*16*). Diagnostic radiology residents who meet the ABNM or ABR requirements, including therapy, can sit for the ABNM certification or ABR nuclear radiology subspecialty certification examination with 16 mo of nuclear medicine during residency training. For ABNM qualification, 12 mo must be obtained in an ACGME-accredited nuclear medicine residency program. For ABR subspecialty certification in nuclear radiology, the 16 mo will qualify in institutions with either an ACGME-accredited nuclear medicine residency or an accredited nuclear radiology fellowship. The ABR Nuclear Radiology subspecialty certification represents a longstanding pathway for ABR diplomates who complete a 1-y nuclear radiology fellowship or choose the new 16-mo pathway during residency; however, these trainees may not be eligible for the ABNM examination in all cases. Thus, there are currently 2 mechanisms by which radiologists can obtain dual certifications.

Authorized User Training Requirements and Certification Process. In June 2006, the NRC granted the ABR "deemed status" regarding the medical use of byproduct material for its diplomates who had completed the required training and experience under the revised rule for authorized user eligibility status and who had also passed those prescribed elements of the ABR examination. When the NRC training and experience requirements were revised, the requirements for "Imaging and Localization Studies" (10 CFR Part 35.290) were decreased from 1,000 to 700 h of clinical training and experience in nuclear medicine and include "a minimum of 80 hours of classroom and laboratory training, in basic science radionuclide handling techniques applicable to the medical use of unsealed byproduct material for imaging and localization studies." In most residency programs, this requirement is accomplished by 4 mo (16 wk) on assigned clinical nuclear medicine rotations as well as by ongoing lecture series, laboratory sessions, and nuclear medicine call duties during the 48 mo of diagnostic radiology residency. The NRC and Agreement States regulate these authorized user criteria.

Medical Student Education and Early Awareness. The small number and generally weak caliber of applicants to nuclear medicine programs may be related, at least in part, to the limited exposure to the field in medical schools in the United States. The Alliance of Medical Student Educators in Radiology distributed a 13-question survey in January 2010 (*17*). Thirty-eight clerkship directors or radiology course directors completed the survey. Twenty-one percent reported that medical students are exposed to nuclear medicine during their first year, and the same number (21%) reported that this occurs during the second year. Nuclear medicine is offered as a basic course or an elective during the third (55%) or the fourth (68%) year. Fifty-five percent of respondents stated that nuclear medicine was not required during the third year; the remainder stated that the requirements for nuclear medicine varied from <1 h to 6 h. During the fourth year, 32% indicated no required hours and 26% reported only 1–2 h of required time. As a corollary, an analysis of 8 radiology textbooks designed for medical students revealed that the number of pages devoted to the field of nuclear medicine varied from 0 to 12.5% of the total (*18*).

Possible Solutions

ACR/SNM Task Force. In 2009, an ACR/SNM Task Force was formed to explore concerns regarding the decline of physicians entering nuclear medicine, career opportunities, prevailing economics, and education pathways. The Task Force has conducted surveys on employment opportunities and hiring practices, practice coverage expectations, and compensation and has evaluated current training pathways and board certification processes in an effort to understand all of the contributing factors that adversely impact careers in nuclear medicine. The task force is preparing its report and will make its recommendations.

New Model: Radiology/Nuclear Medicine Combined Residency Program. A recent article suggested that one of the pathways to nuclear medicine board certification could be through a new radiology/nuclear medicine combined residency program (*7*). Such combined residency/fellowship programs have been successful at large universities (*19*). Graduates of such programs would likely not face the same obstacles and biases in securing a job. At a recent panel discussion (*20*), it was pointed out that the declining trend line for jobs advertised in *The Journal of Nuclear Medicine* from 2003 to 2006 would have predicted virtually no job openings in 2010. Using data for 2007 to 2010, the graph indeed shows a continued decline in the number of jobs, with an abrupt drop-off for 2009–2010 (Fig. 1).

A more immediate approach would be to design an accelerated radiology residency program for qualified nuclear medicine residents (or recent graduates) to train in order to become ABR certified. This could be a program emphasizing the core anatomic modalities of CT, MR, and ultrasound; however, such a program should ideally include some training in other radiologic disciplines, such as mammography because of the potential of breast-specific γ imaging (*21–23*) and positron emission mammography (*24–26*). Similarly, vascular and interventional radiology training may be helpful as a result of the development of new oncologic radiotherapies administered via strategically placed catheters (*27*).

In either scenario, in light of the worsening employment situation for physicians with only nuclear medicine training, a realistic assessment is required of how many dedicated nuclear medicine residency slots are needed today and how

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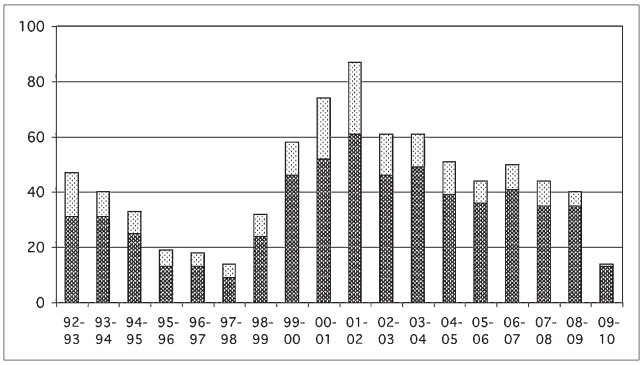

FIGURE 1. Jobs advertised per year in *The Journal of Nuclear Medicine.* Dark field = positions requiring radiology residency training. Light dotted field = positions accepting training in fields other than radiology, usually internal medicine.

many will be needed in any future combined radiology/nuclear medicine programs. The perfect number of positions to reach equilibrium with the prevailing job market is not now known. It would seem reasonable to estimate that it should likely not be more (and probably should be less) than the number of approved positions currently available.

Enhanced Marketability. Specialists who are dual-boarded in radiology and nuclear medicine will likely be able to compete more successfully in the marketplace. Perhaps this dual-training pathway will become essential in the not-too-distant future.

Future Directions

Nuclear medicine and radiology must work together to realize the full promise of our integrated specialties. The introduction of new radiopharmaceuticals, notably for PET, and the emergence of newer hybrid imaging techniques may increase the demand for more nuclear medicine specialists in coming years. These specialties must join forces to develop and advance the emerging field of molecular imaging. However, molecular imaging will not be performed exclusively by experts in nuclear medicine, given recent advances in optical imaging, nanotechnologies, ultrasound imaging with microbubbles, and MR spectroscopy. It is hoped that nuclear medicine education can begin during medical school and that diagnostic radiology residencies will embrace more rigorous training in nuclear medicine.

Conclusion

Newly graduated nonradiologist nuclear medicine physicians currently face an increasingly challenging job market. Possible short-term solutions include acquiring more CT training or pursuing a conventional radiology residency program. Possible intermediate-term solutions include developing a hybrid accelerated radiology residency program, if it can be approved and established within a few years. For the long term, however, a combined radiology/nuclear medicine residency program, ideally yielding expert specialists with dual certifications, would be the best course for the profession as a whole as well as a wise choice for those talented physicians interested in practicing and advancing the dynamic fields of nuclear medicine and molecular imaging.

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SNM Membership Categories Expanded; New Award

Over the past 4 y, SNM has expanded from a society focused solely on nuclear medicine to an organization that incorporates all facets of molecular imaging. This includes not only PET and SPECT but also molecular imaging using optical, ultrasound, MR imaging and spectroscopy, and other methods. The work of SNM's Center for Molecular Imaging Innovation and Translation (CMIIT) has resulted in many successes that are reflected throughout the organization: expanded educational offerings, meeting programming, publications, and much more. Individuals involved with any of the diverse areas of the field—whether developing new diagnostic agents, investigating molecular imaging biomarkers, or creating molecularly targeted therapies—will find something of value.

In addition to updating the already diverse membership categories we offer, SNM has created new categories for molecular imaging laboratory professionals. Several types of membership are now available for non-PhD individuals involved in molecular imaging research. These are currently being offered at a special introductory rate.

CMIIT values the important contributions made by these technical staff working in molecular imaging laboratories and is pleased to announce a new forum for laboratory staff recognition. With this year's inaugural Laboratory Professional Recognition Award, principal investigators and facility directors will be able to highlight the efforts of laboratory professionals, recognizing innovative and effective tools, techniques, technical innovations, and practices in molecular imaging. CMIIT hopes that this travel award will offer an opportunity for these valuable contributors to step out of the shadows and that the opportunity to attend the SNM Annual Meeting will inspire young laboratory professionals to take an interest in molecular imaging as a career.

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This award is distinct from the Young Investigator Award presented during the Annual Meeting and is specially created for non-PhD laboratory professionals. Publication of the work cited is not a requirement. SNM members are encouraged to nominate staff from their laboratories for this award. For more information about our new membership categories and discounts, visit www.snm.org/categories or call SNM at (703) 708-9000. For more information about the Laboratory Professional Recognition Award, visit www.molecularimagingcenter.org/labs or contact Jen Rice, CMIIT senior program manager, at (703) 742-5498.

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