Stronger Together—Collaboration Will Only Enhance Patient Care

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The future of nuclear medicine (NM), molecular imaging, and theranostics is indeed bright. Its evolution from "unclear medicine" to its current stature as a field has helped lead health care toward precision medicine. This journey started over 20 y ago with the advancement of PET instrumentation and radiopharmaceuticals, and more recently the field has experienced a renaissance through the development of radiopharmaceutical therapy and theranostics. Throughout this evolution and transformation, the practice and science of NM have benefitted from the breadth of disciplines embraced by the field—clinical imaging and therapy, molecular biology, physics, chemistry, and mathematics. Multidisciplinary training and practice for physicians have also been important for advancing NM; however, we physicians, unlike our basic science partners, have at times struggled with these collaborations. We believe that collaboration is imperative for best practices in patient-centered medicine and education.

The elephant in the room is who will be allowed to practice theranostics and radiopharmaceutical therapy in the United States and whether collaboration with fields outside NM will lead to the demise of the specialty in the United States. In this issue of *The Journal of Nuclear Medicine,* Dr. Graham seems to suggest that NM in the United States must become a truly independent specialty to survive and thrive in the era of theranostics and that failure to develop truly independent training and practice may lead to the decline of NM (*1*). We would like to offer a different opinion. We do agree with Dr. Graham that, outside of the United States, different regulatory and cultural factors support NM training and practice. As such, we confine our comments to training and practice in the United States, taking some cues from practices elsewhere, particularly in parts of Europe, that support a more independent NM practice than is the current U.S. standard.

Let us take a moment to look back before we look forward. We can draw multiple lessons from the past to reflect on the evolution of medical practice that is relevant to this discussion. At one time, radiologists could practice radiation oncology. In the 1970s, the American Board of Radiology recognized that therapeutic radiology and diagnostic radiology (DR) had different needs for training and experience (*2*). As a result, the American Board of Radiology discontinued training in general radiology inclusive of both diagnostic and therapeutic radiology and divided the field. In addition, the American Board of Radiology further changed training requirements in 1997 and added a year of training such that the program became 4 y after internship (*3*).

In 1999, the Committee on Advanced Subspecialty Training brought together disparate specialties in establishing standards for training and competence. Before this committee, some physicians believed they were competent to practice angiography-based neurointerventional and endovascular surgery after participating in a mini fellowship that may have been of variable quality and length. Subsequently, leaders from neurology, radiology, and neurosurgery convened and established strict training and practice standards and pathways by which those from neurology, neurosurgery, or radiology backgrounds could achieve the training required to gain credentialing in neurointerventional practice (*4*). In this instance, it is worth noting that someone trained in radiology cannot simply complete this extra year alone but must do a neuroradiology fellowship year first or have been trained in a hybrid program.

The so-called disruptive technology of hybrid imaging brought our specialty to new heights of clinical interest and impact and required an expansion in training on cross-sectional anatomic imaging (*5*), leading to lengthening of NM residency training starting in 2007 (*6,7*). This was accomplished through partnership with radiology programs that specialize in this type of training but also engendered considerable angst about who would be allowed to read PET/CT in clinical practice. Nonetheless, this disruption was a benefit to patients and our field.

Once again, we face a similar challenge with theranostics, in which radiopharmaceutical therapy is at the heart of NM practice but also benefits from other clinical disciplines familiar with the treatment of cancer, especially radiation oncology and medical oncology. As was the case for PET/CT, the challenge of multidisciplinary training creates territorial controversy over who should practice radiopharmaceutical therapy. Recent divisive statements from the American Society for Radiation Oncology suggest that theranostics' home should be largely within radiation oncology (*8–11*). Though radiation oncologists have good training in the management of a variety of cancers and are well versed in radiobiology and radiation toxicity, there seems less attention paid to the critical differences between external-beam and unsealed-source radiotherapy, the intricacies of internal dosimetry, the importance of relevant image interpretation, and other unique aspects of care for theranostics patients.

Even though radiopharmaceutical therapy is part of the required curriculum for radiation oncology, and has been for some time

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(*12*), many of us at academic centers with radiation oncology training programs find that because of scheduling difficulties and clinical demands in the trainees' primary specialty, it is often difficult for them to have continuity with patients over time to observe important concepts. Even for radioiodine therapy for thyroid disease, the training provided by most radiation oncology programs is cursory at best, not infrequently consisting of observing the minimal number of procedures in NM and often missing the clinical consultation for the same patient, which involves key decision-making, including radiation safety considerations.

With this history as a background, we would like to address Dr. Graham's points and offer potential solutions. One of his suggestions is to "stop inadequately trained radiologists from practicing NM." This statement needs to be broadened to read, "stop inadequately trained physicians from practicing NM." We agree that the 4 mo or less in which DR residents train in NM are insufficient to practice NM at a higher level. Yet, attempting to exclude DR-certified physicians from the practice of basic NM diagnostics (e.g., bone scans and ^{18}F-FDG PET/CT) will likely be a quixotic effort and precipitate an even greater shortage of qualified readers. Rather, we suggest making sure that more advanced practice components of NM—such as parenteral radiopharmaceutical therapy—are performed by physicians well trained in these areas, as is the case for NM-certified physicians. For example, in internal medicine, general practitioners contribute to the management of patients with minor or well-treated cardiac disorders, but advanced practice and procedures are reserved for board-certified cardiologists, many of whom have subspecialty training in advanced cardiology practices (*13*).

Dr. Graham suggests adding "one more year to the NM residency program that would be primarily research but could also emphasize involvement in radionuclide therapy, since that is becoming a growing part of what we do." In terms of training, we note that the rapid evolution of therapeutic radiopharmaceutical practice in the last few years has led to changes in requirements for training in the form of milestone updates from the Accreditation Council for Graduate Medical Education and procedure requirements from the American Board of Nuclear Medicine, which acknowledge the need for additional training in the context of many new agents, including both β- and α-emitters, that create complex clinical management questions. With that said, we strongly agree with this suggestion of additional training in radionuclide therapy for those practicing theranostics, with an opportunity for clinical or translational research for those centers with active therapy research programs. The future of NM as a preferred specialty for radiopharmaceutical therapy depends on our ability to help direct treatment integration across specialties and to manage the toxicities of our treatments in myriad patient populations. Here in the United States, we can ask our clinical collaborators in medical oncology and radiation oncology to help cross-train NM residents and fellows, just as we may also help train their residents and fellows. Collaborating in training would not only give a greater understanding of the next steps in therapy, about which some of our patients may inquire on clinical visits, but also enhance the mutual respect of each discipline.

Perhaps it is time to start a Committee on Advanced Subspecialty Training of our own. We propose that it is time not only for a shift in practice similar to what occurred in the 1970s vis-à-vis radiology and radiation oncology but also for establishment of training and qualification in theranostics such as the Committee on Advanced Subspecialty Training process by leaders in radiation oncology, radiology, medical oncology, and NM. We realize that in most cases, this will lead to an addition of time to existing training and not simply a repurposing of already allotted hours within an existing program. One such possibility is the additional year that has already been proposed by the Society of Nuclear Medicine and Molecular Imaging, after a request for proposals for a nuclear oncology fellowship program with additional training in theranostics (*14*). This additional year could include an emphasis on theranostics (with relevant imaging and therapy training), physics, and dosimetry. The Committee on Advanced Subspecialty Training could decide how to fill gaps in knowledge related to those trained in different disciplines and the appropriate additional hours required depending on background. Understanding the management of sequential or combined treatments and the toxicities of systemic anticancer therapy and therapeutic radiation—all important to theranostic practice—should be essential parts of training. For example, NM trainees may have less exposure to training in areas such as palliative care, hospice, survivorship, and nutrition and would benefit from expanding knowledge in these areas. Again, these are simply suggestions and a starting point from which discussion could commence; we do not seek to definitively recommend the exact criteria within this short editorial.

On the topic of research training, Dr. Graham's editorial laments the demise of clinical and translational research in NM. Members of the older generation of NM physicians, who were more likely to come from specialties other than radiology, such as internal medicine or NM-only programs, contributed greatly to research and advancement in NM. However, the same can be said for practitioners trained in radiology and NM, and in fact, the contribution of DR/NM-trained physician researchers is increasing, benefiting from the evolution of radiology training to include training of physician–scientists in addition to clinical practitioners. At least 10 academic radiology departments have dedicated physician–scientist training programs, at least 6 with National Institutes of Health training grants and with more under development. The programs are increasingly attracting research-interested medical students, including those trained in MD, PhD, programs. Many physician–scientist training programs have molecular imaging and NM as a leading concentration for physician–scientist trainees. NM-focused faculty comprise a large component of the Radiological Society of North America's Clinical Trials Methodology Workshop, with an increasing fraction of workshop students who propose molecular imaging/NM clinical trials as part of their workshop experience. Our specialty can learn from—and build on—these multidisciplinary experiences in translational and clinical research training to advance research and physician–scientist research training.

Dr. Graham's editorial argues that the NM workforce is becoming increasingly strained in the United States and that—for multiple reasons, including fewer Accreditation Council for Graduate Medical Education–certified training programs, the penetrance of DR into the field, and the perceived lack of dedication by international medical graduates to NM—NM does not have the bandwidth to meet the demand. He argues that we are paying the price for the medical community's poor impression of NM trainees, who may find it difficult to find jobs after dedicated NM training without also having radiology training. One point that Dr. Graham makes is that "a significant weakness of the above discussion is lack of hard data" on the outcome of training on future employment and the impact on the practice of NM. In this we agree with Dr. Graham. It is difficult to make broad policy recommendations without these reliable data. As such, we requested information from the American Board of Radiology, American Board of Nuclear Medicine, and Accreditation Council for Graduate Medical Education DR and NM residency review committees. Although we are grateful to those who did respond, we did not receive holistic

information from all parties by the deadline of this article. We would like to suggest that there be wide transparency of this information for the betterment of all and the future of education.

Thus, we arrive at the final suggestion in Dr. Graham's editorial: "develop a strong and effective long-term informational campaign directed at medical students," which should be done at a national level because directors of NM in individual programs have "repeatedly failed" in this regard. We are grateful for the nationally based approaches advocated by the Society of Nuclear Medicine and Molecular Imaging, the American College of Nuclear Medicine, and others. But we believe it is important not only to look to the stars but also at ourselves. Many specialties jockey for the attention of medical students. But if we make NM and theranostic training a collaborative multidisciplinary path dedicated to creating an advanced patient-facing high-tech professional specialty, medical students will be drawn to the field. This is, for example, the case for the new IR/DR integrated training pathway, which is growing quickly in popularity. The Society of Nuclear Medicine and Molecular Imaging is currently assembling a new video campaign aimed to address all aspects of careers in NM. This effort is laudable but will not fully replace the grassroots endeavors that will be required to teach medical students locally about our exciting and developing field. We all need to be willing to be the change we want to see where this is concerned.

In summary, NM was built on a multidisciplinary approach to radiopharmaceutical imaging and therapy, an inclusive approach that brought together specialists from a variety of training pathways that included medicine, radiology, endocrinology, and pathology, among others. The future of the field in the United States depends on training NM practitioners who understand NM imaging and therapy practices, as well as the clinical and basic science that underpins practice. This effort requires dedicated pathways and an integrated approach to NM training. Existing as an independent specialty at the expense of collaboration and cooperation with closely allied and essential disciplines may paradoxically weaken our field and our ability to care for patients. We are stronger when we work together.

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