Introduction

This volume entitled "Issues and Controversies in Nuclear Medicine" is the final of 7 supplements published under the remarkably successful tenure of Dr. Heinrich Schelbert as the Editor-in-Chief of *The Journal of Nuclear Medicine.* The topics of these supplements reflected the changing playing field of nuclear medicine and summarized the initial experience with PET/CT (2004), its impact on patient management (2007), the emerging field of molecular radiotherapy (2005), the role of molecular imaging in cancer (2008), imaging approaches to personalized medicine (2009), and finally, the utility of multimodality approaches for imaging the cardiovascular system (2010).

The current supplement addresses pressing issues and ongoing controversies. Several of these have resulted from rapidly evolving hybrid imaging technologies. PET/CT (*1*) has become the state of the art in diagnostic oncology; SPECT/CT is increasingly used in several fields of nuclear medicine; and a further hybrid imaging technology, PET/MRI, is entering initial clinical studies. Delbeke et al. (*2*) and Dondi et al. (*3*) provide overviews of how these new technologies are affecting the practice of nuclear medicine in the United States and in developing countries, respectively. The implementation and adoption of hybrid imaging approaches mandate fundamental changes in the nuclear medicine training curricula for both physicians and technologists. Furthermore, the interaction among radiologists, nuclear medicine specialists, and clinicians is undergoing dynamic and dramatic changes. Nuclear medicine as an independent discipline is therefore at a crossroads, as discussed by Schelbert (*4*) and Larson (*5*), who propose how both nuclear medicine and radiology need to adapt to these challenges.

In parallel to the development of new systems for multimodality imaging, hundreds of new diagnostic and therapeutic radiopharmaceuticals have been developed and tested preclinically. Clinically, however, ^{18}F-FDG remains the only molecular imaging agent that is approved and reimbursed in most countries. Even ^{18}F-FDG reimbursement is restricted in some countries, such as Canada and Germany, because regulatory agencies in these countries have changed the level of evidence that is required for approval and reimbursement of diagnostic tests. Although proof of improved diagnostic accuracy used to suffice, impact on management and patient outcome now also needs to be documented. However, serious questions and concerns can be raised about the methods applied by health technology assessment groups to evaluate the value of diagnostic procedures. Ware et al. (*6*) illustrate these issues in their scathing criticism of the assessment of PET by Australian regulatory agencies, which are further commented on by Weber (*7*). In contrast to therapeutic procedures, there are neither generally accepted definitions for the clinical benefit of imaging tests nor agreement as to which trial design is appropriate to demonstrate such a benefit. Vach et al. (*8*) discuss various approaches for the clinical evaluation of imaging tests and argue that in several common scenarios randomized trials are unnecessarily expensive and not adequate to demonstrate a clinical benefit.

The use and sometimes exploitation of evidence-based medicine to restrict access of patients to novel imaging techniques is caused by serious concerns about rising health-care expenditures worldwide. These concerns have prompted increased scrutiny of the use of diagnostic procedures that are frequently perceived to be expensive and not cost-effective. But is imaging, and PET/CT in particular, really a driving force in rising health-care expenditures? Yang and Czernin's (*9*) analysis suggests that this is not the case.

The National Oncology PET Registry has provided evidence of a dramatic impact of PET on patient management across all cancers and indications. This has led to expanded coverage by the Centers for Medicare and Medicaid Services for ^{18}F-FDG imaging in cancer in the United States. On the other hand, novel diagnostic and therapeutic nuclear medicine approaches such as radiopeptide imaging and therapy have become accepted in some regions (Europe) but are not available in others (United States). The current state and availability of these approaches in the United States and Europe are discussed by Graham and Menda (*10*) and Ambrosini et al. (*11*), respectively.

Recent surveys have demonstrated a substantial variability in PET and PET/CT operations across institutions and countries (*12,13*). Standardization approaches to address this issue have been proposed by Boellaard (*14*). Without such standardization, further rapid growth of PET/CT cannot be expected.

There is a need for more PET imaging probes to meet the demands for personalized medicine. Schwaiger et al. (*15*) hypothesize that 3 factors define the need for novel PET probes: First, PET will challenge SPECT in advanced health-care markets supported by a specialized radiopharmaceutical industry. This will result in a diversified PET probe portfolio. Second, the growth of PET will be accompanied

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by increasing availability of PET probes. And third, the success of translating molecular PET probes will depend on the integration of molecular diagnostics and therapeutics.

The combination of PET and CT in PET/CT has raised concerns about radiation exposure of cancer patients. Although no data (other than modeled data) exist to provide any evidence of increased cancer risk when appropriate populations are studied, we need to address these concerns proactively. This is done by Freudenberg et al. (*16*), who review the public perception of radiation risk and conclude that educational efforts should be directed toward physicians and lay people to alleviate fears.

It is hoped that this supplement, by presenting facts and opinions about many controversial issues, will stimulate constructive discussions about the presence and future of nuclear medicine and molecular imaging.

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