

Challenges in Realizing the Potential of Clinical Molecular Imaging

Global megatrends, such as growing and aging populations, combined with the increasing prevalence of diseases such as cancer, heart disease, and dementia, lead to inexorably and exponentially increasing health care costs. In the United States alone, the number of individuals who are 65 y old and older will double by 2030. If our children and grandchildren in 2030 continue to accept the way we practice medicine today, the following trends will continue: 1 in 3 individuals will experience some form of cancer, half will not survive a first chest pain, and 20% will develop disease that prevents them from recognizing their own grandchildren. The need to reverse these trends is among the primary motivators that drive both scientific and industry investment in health care.

The economic tolls are staggering. In the United States, every 33 s a citizen dies of heart disease, the aggregate costs for which exceeded \$400 billion in 2006. In 2007, 1,444,920 individuals were diagnosed with cancer, for which direct costs exceeded \$210 billion in the last year figures were available. Every 72 s a citizen develops Alzheimer's disease, for which direct annual costs are projected to be \$160 billion by 2010.

Many observers believe that molecular imaging is destined to play a key role in enhancing our ability to address the challenges of these diseases and, with advances in technology and basic science, to work toward reversing negative trends. Michael Phelps, PhD, director of the Crump Institute for Molecular Imaging and Norton Simon Professor and chair of Molecular and Medical Pharmacology at the University of California at Los Angeles, has said: "In medicine and biology there is a new playing field. It's all molecular, and it's going to change the world we live in." Advances in PET and PET/CT are leading to significant changes in patient management in oncology and are joining a growing range of molecular modalities that generate high-resolution anatomic and metabolic data.

A few examples of the areas in which PET and PET/CT are having significant effects in major disease settings illustrate the range and promise of these techniques. Fulham and Scott presented data from the Australian PET Data Collection Project at the 2007 SNM Annual Meeting in Washington, DC, indicating that PET/CT changed management in 59% and type of management in 49% of patients with ovarian cancer. In the same presentation, the authors reported that PET imaging changed management

plans for 66% of colorectal cancer patients under investigation for recurrent tumor after initial therapy and that new disease was identified in 48% of these patients. Reinhardt and colleagues reported in the *Journal of Clinical Oncology* (2006;24:1178–1187) that PET/CT changed management in 48% of patients at N and M staging of cutaneous melanoma. In 2003, Panigrahy and colleagues compared PET/CT with PET alone in young patients with a range of pediatric cancers and found that the hybrid modality improved lesion characterization in 88% of patients and changed clinical management in 68%.

What the Public Knows About PET

Despite these types of successes, molecular imaging and PET/CT specifically face a major challenge. Current utilization rates show that PET/CT is lagging far behind its potential. In the United States in 2006, more than 20 times as many oncologic CT studies were performed than PET and PET/CT procedures combined. We frequently hear about growth in PET and PET/CT, but these studies rarely look at this growth against the much larger backdrop of oncologic imaging as a whole. One barrier to clinical adoption of PET/CT has been identified in a lack of appropriate information in the medical community. Knowledge of PET/CT among members of the general public also presents obstacles. Although the Internet and other tools have increased the desire to know more about disease and treatment among at least a portion of the public, many remain unfamiliar with the devices and tests that assess disease.

In 2006 Siemens conducted a random online survey of 1,111 adults, only half of whom could accurately identify a PET/CT as a medical imaging device. Nearly 1 out of 4 people believed PET/CT to be a high-intensity screening device for use in airport security. Ten percent believed it to be a device for monitoring pregnancy, and 15% believed it to be a "device used by a veterinarian to monitor brain waves in animals." On a different note, the survey also asked a genomic/proteomic question: "Would you take a test that identifies diseases you will have 20 years before symptoms occur?" Seventy-two percent of respondents said yes, and 28% said no.

The Benefits and Challenge

Getting the word out about molecular imaging technologies is critical as individuals invest more time and scrutiny in their own health care and the health care choices that are

made on their behalf by physicians and regulatory agencies. PET/CT is proving on a daily basis to be the diagnostic tool that can make a real difference for many patients. We all know that molecular imaging and molecular medicine procedures, if administered appropriately, can change diagnosis and disease progression in cancer, but we are faced with the challenge of conveying this information to those it can most benefit.

At the same time we must find creative but evidence-based ways to convey the message to referring physicians that molecular imaging provides personalized and predictive advantages not facilitated by other approaches. Among these advantages are the ability to distinguish responders from nonresponders, predict and quantify responses to therapy, rapidly assess treatment effects, verify therapeutic targeting, identify appropriate patients for alternative therapies, delineate personalized target volumes for radiotherapy, and assist pharmaceutical companies in accelerating the bench-to-bedside development of beneficial agents.

Elias Zerhouni, MD, the director of the National Institutes of Health, believes in this message. He said, "If

we are going to take advantage of the current explosion of knowledge in genomics and proteomics on a clinical basis, then nuclear imaging with radiopharmaceuticals is the way to go. Although a lot of research has been undertaken in MRI, ultrasound, and even novel optical imaging approaches, none of these have the potential of nuclear imaging." The surroundings are rather positive—many people out there believe in molecular imaging and molecular medicine. We just have to find the right methodologies to reach out.

In addressing the underutilization of molecular imaging in daily clinical practice we must focus on informing all interested individuals about both the clinical and the economic benefits, a task that will be easier if we are willing to invest in outcomes studies. Collaborative effort is clearly needed as we move together along this promising road to personalized medicine.

*Markus Lusser
Siemens Medical Solutions USA Inc.
Hoffman Estates, IL*

Strategies in Education and Outreach

Reaching out to patient and professional audiences requires careful consideration of the message, the needs of the audience, and the method of delivery. When reaching out to patients, for example, organizations often aim to influence knowledge, attitudes, and behaviors. The relevance of the message, coupled with an understanding of the unique needs of individuals in varying subgroups to learn more about their disease and treatment options, leads to successful educational initiatives and outreach. Delivery vehicles such as in-person programs, print publications, Web-based communications, and innovations in education, such as teleconferences, are among current strategies, and each is enhanced by a clear perspective on what does and does not work with specific groups. In addition, evaluation efforts are critical in measuring the success of these efforts.

Implementing Effective Outreach

At the Lymphoma Research Foundation (LRF), we work, among numerous other missions, to translate increasingly complex medical information for a range of patients and their families and to devise innovative methods for getting important messages out to these and other groups. One advantage is that it is easier to educate patients than to change the health care system itself, so this is an area in which substantial inroads can be made by careful planning and targeting.

Several key constructs structure our work in patient education and outreach. The first of these is the need to

appreciate that the ability of any single adult or group of adults to take in information varies, depending on a number of factors. Moreover, this variance can occur within the same individual at different times. A person's ability to process complex medical facts about non-Hodgkin's lymphoma (NHL), for example, may be quite compromised immediately after his or her diagnosis with the disease, whereas at another time this information may be welcome. Second, patient outreach efforts must be disease-centric. Individuals are interested in their (or their family members' or friends') specific type of disease. Therefore, at LRF and other disease advocacy groups, the emphasis in recent years has been to make sure that useful information is available on each disease rather than on umbrella disease groupings. The third construct is the need for information on treatment. Simply providing background information on a disease does not go to the central question every patient has: what is the best option for my treatment? It is important to offer appropriate information on treatment options and clinical trials. Finally, patients and their families and friends need additional avenues of support. All of these constructs provide important criteria by which information can be more accurately and helpfully targeted at those who need it most—patients, survivors, and loved ones.

Three Strategies for Outreach

At LRF, we have identified 3 strategies for effective outreach to patients: refining the applicability of the message,