Nuclear Medicine in the 21st Century: Integration with Other Specialties

"Integration"—the watchword of the 1960s civil rights movement, and now a catchword of modern business management—is also a concept becoming more and more frequently used by nuclear medicine leaders, scientists and industry leaders. Just as academic disciplines, telecommunications firms, hospitals, and other businesses have been merging and reconfiguring their organizations, many nuclear medicine physicians are contending that nuclear medicine needs to integrate with other specialties such as cardiology, oncology and surgery in order to increase the demand for nuclear medicine procedures in managed health care systems. In essence, nuclear medicine can no longer be a separate-but-equal medical specialty. "Integration is the key to our future," asserted Henry N. Wagner, Jr., MD, professor of medicine, radiology and environmental sciences at the Johns Hopkins Medical Institutions in Baltimore, MD.

Nuclear medicine departments at several leading academic institutions throughout the country have already begun to create stronger connections to other medical specialties, as well as to the biological sciences.

In the most dramatic example of integration, the nuclear medicine division at the University of California Los Angeles (UCLA) School of Medicine has merged with the Department of Pharmacology in 1993 to form a new Department of Molecular and Medical Pharmacology. Other institutions, like Memorial Sloan Kettering Cancer Center in New York, have integrated nuclear medicine with other specialties through weekly conferences and grand rounds. Perhaps the most symbolic intertwining of nuclear medicine with other medical specialties is the recent advent of a combined PET/CT scanner. In a technique called "fusion imaging," the scanner can perform back-to-back CT and PET studies to provide both anatomic and metabolic information in a single scan session. (See box on page 21N.)

Making Peace After the Turf Battles

Through the 1971 establishment of its own primary certifying board—the American Board of Nuclear Medicine (ABNM)—nuclear medicine worked to set a name for itself as an independent medical specialty. It had been left with a few battle scars after making a break from radiology. "During the 1970s, nuclear medicine was trying to establish its own turf, and we were always on the defensive," explained Wagner. "Now that we have established ourselves as a strong medical specialty, we need to integrate with other departments and develop relationships that can benefit the institution as well as the patient." At Johns Hopkins, nuclear medicine has always been part of the radiology department, but this partnership has grown stronger through the years as the two specialties have developed a nearly symbiotic relationship. Recently, the department established a PET radiopharmaceutical network that will soon begin providing PET tracers to local hospitals. "Nuclear medicine has quadrupled its space, and we are getting a new PET scanner and cyclotron," said Wagner. He emphasized that the project was the result of a close collaboration between the nuclear physicians and radiologists within the department.

Although radiology has traditionally been paired with nuclear medicine, other specialties like cardiology and internal medicine have also crossed over into nuclear medicine. The establishment of the American Society of Nuclear Cardiology several years ago provided a merging ground for cardiologists and nuclear physicians. Moreover, the ABNM recently submitted a proposal to the American Board of Internal Medicine to develop a dual residency program, just as it has with radiology.

Nuclear physicians with dual specialties have traditionally been radiologists or cardiologists, but whether they can actually integrate nuclear medicine with other specialties remains an unanswered question. "Physicians from other specialties such as oncology and psychiatry have expressed some recent interest in receiving board certification in nuclear medicine, but whether there will be jobs for these people has yet to be determined," said R. Edward Coleman, MD, a professor of radiology and director of nuclear medicine at Duke University Medical School in Durham, NC.

Teaching hospitals throughout the country have

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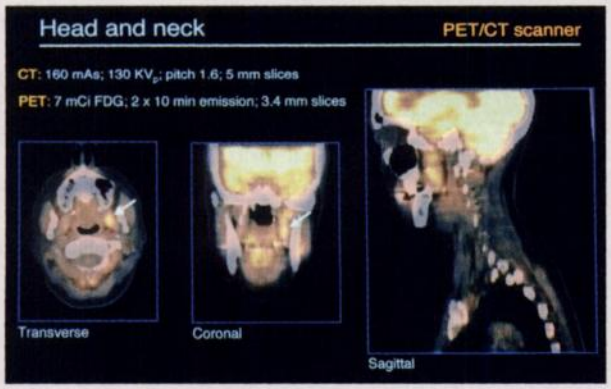
begun their own training programs to enable residents in various specialties to rotate through nuclear medicine departments as part of their training. "We've built joint training programs and joint clinical programs with internal medicine, similar to those we have with radiology," said Michael Phelps, PhD, chair of the Department of Molecular and Medical Pharmacology at UCLA. "In addition, we have faculty from medicine, pediatrics, neurology and psychiatry that participate in our general nuclear medicine readouts to increase our knowledge and involvement in medical management and for them to increase their knowledge about the benefits of nuclear medicine, as well as to be our advocates within their practices."

A Partnership with Molecular Medicine

When Phelps first conceived of merging nuclear medicine and pharmacology at UCLA six years ago, he recognized the contribution that nuclear medicine could make to the newly emerging field of molecular medicine, which itself grew from the merger between modern biology and medicine. "I wanted to establish an academic environment where basic biological and physical scientists could come together with clinical scientists to contribute to the revolutionary advances occurring in the field of molecular medicine," Phelps said. "The new department would bring together diagnostic and therapeutic concepts of nuclear medicine and pharmacology to be a part of the new molecular medicine."

The Value of a PET/CT Scanner

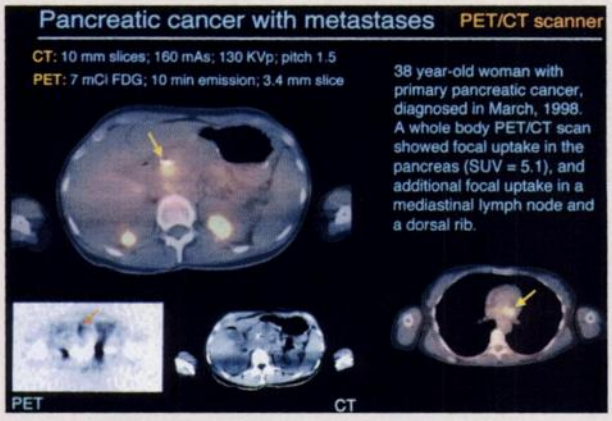


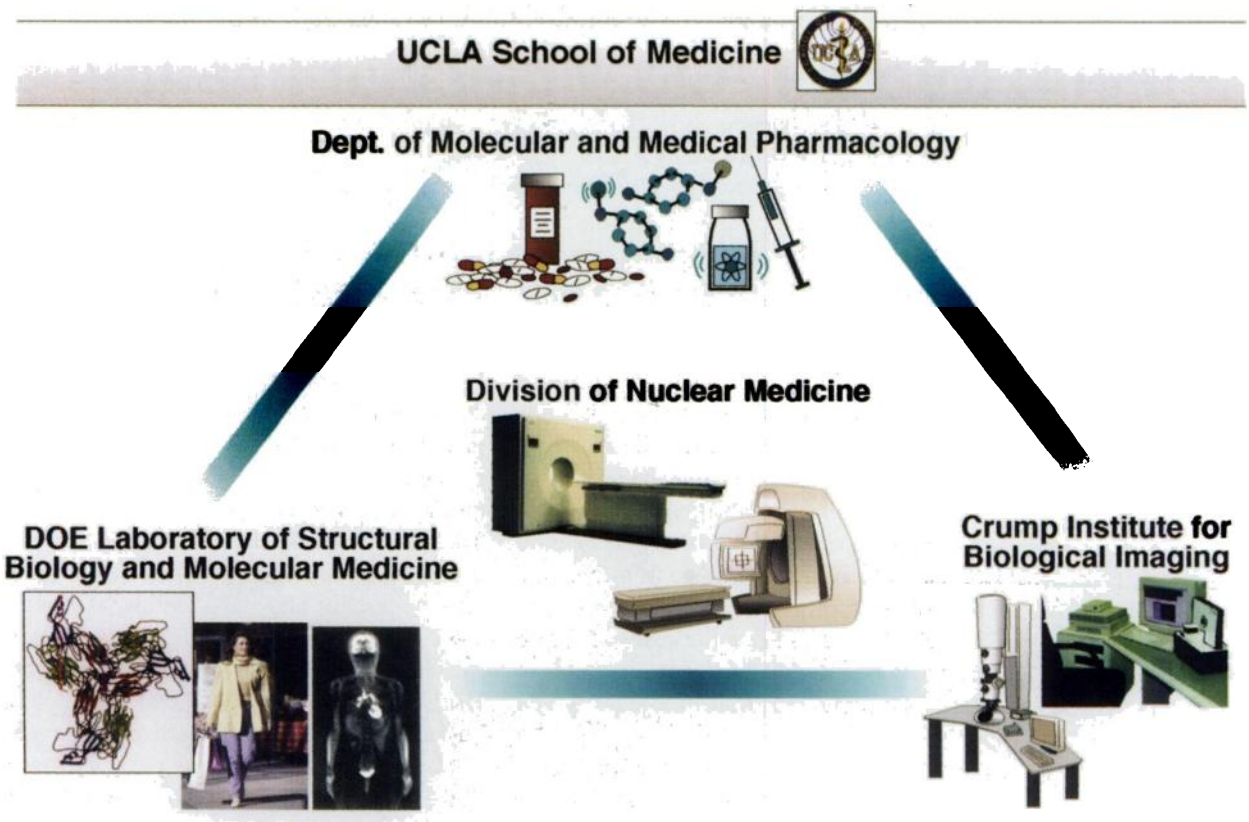
A new imaging system that combines PET and CT in a single scanner is currently being tested in research trials. Primarily useful for oncologic imaging, the fusion imaging system will enable physicians to obtain a CT scan and PET scan in a single session, making it easier to align the anatomic features of a CT scan with the biological information shown by PET. Currently, radiologists must perform CT and PET scans in separate sessions, during which a patient's position may have shifted. The shift in turn may cause a movement of organs that makes the alignment of images difficult to achieve. "Since PET gives limited anatomical information, it is often difficult to pinpoint the exact location of a tumor in a PET scan, especially in the abdomen and in the head and neck," explained David Townsend, PhD, an associate professor of radiology and senior PET physicist at the University of Pittsburgh. Townsend helped invent the PET/CT scanner.

In an abstract presented at the Society of Nuclear Medicine Annual Meeting in Los Angeles, Townsend and his colleagues compared whole-body images taken with the PET/CT scanner with PET imaging alone. They found that the combined system offered "better localization of lesions for surgical planning, differentiation of normal variants versus juxtaposed neoplastic processes, and characterization of biopsy sites."

The PET/CT scanner would be purchased as a separate system since a CT component cannot be added on to existing PET scanners already in use, according to Townsend. "The cost will vary depending on the system," he said. "A nuclear medicine department may want a high-performance PET with a moderate performance CT, whereas a radiology department may want the opposite." Still, the combined system will be less expensive than purchasing the two machines separately since many of the same components can be used for both. "We have had responses from nuclear medicine physicians, radiologists and oncologists at the conferences where I have been lecturing," Townsend said. "So far, the interest has been overwhelming."

The dual scan takes an average of 30 minutes to perform, though some scans may take more than one hour (depending on the size of the area being imaged). The PET/CT scanner will be marketed by Siemens CTI PET Systems in Knoxville, TN, and will probably not become available until the end of the year 2000, according to Townsend. In addition, General Electric (GE) Medical Systems in Milwaukee, WI, has developed a fusion imaging system that combines a SPECT scanner with a coincidence detector and a CT scanner for anatomic images. The GE "Hawkeye" scanner is currently awaiting approval from the Food and Drug Administration.





UCLA, the DOE, and NIH have joined forces to develop new drugs and study the way they alter biological processes.

He recalled that his idea of merging these two disciplines was met with some opposition at first. "There were difficulties in transferring nuclear medicine from radiology to pharmacology and bringing such diverse faculty and students together to implement this new concept," he said. "Some people at UCLA were concerned that I was going to build just an imaging department," Phelps said. "They did not see the wonderful way we could merge the principles of modern pharmacology and biology with biological imaging to create a new school of thought where imaging could provide a unique way to watch and measure the integrated function of cells, viruses, organ systems and organisms." What began as a somewhat risky experiment is now a fully integrated department with a singular vision (albeit a diverse approach to achieving it).

As members in a department with nuclear medicine, the basic biological science faculty in Phelps's department have integrated imaging in their research projects. Researchers have been able to more readily employ nuclear imaging in their protocols thanks to the recent invention of microPET, a miniature PET scanner that can be used to image small animals. MicroPET is being used to image genetically engineered mice to see if they are expressing the correct gene or to monitor the location and degree of expression in gene therapy in living animals. Various current projects range from studying the molecular/genetic mechanisms of cancer to learning about the mechanisms for DNA integration into host cells by viruses that cause disease or are used as vehicles for gene therapy. Some researchers are also exploring the neurochemical basis of normal cerebral function and its alterations in disease, the identification of the antigen for diabetes and its treatment, NO signal transduction, and COX-2 inhibitors for the treatment of inflammatory disease, cancer and Alzheimer's disease. The overall aim of these basic science studies is to develop new pharmaceuticals and radiopharmaceuticals, some of which will then be tested in clinical trials within the same department. Attracted to the fact that a single department, housed within a renowned medical school, can both develop new drugs and study the way they alter the biological processes of disease, pharmaceutical companies, the Department of Energy and the National Institutes of Health have provided research grants to UCLA (see "Pharmaceutical Discovery and Development," p 22N). The Department of Molecular and Medical Pharmacology, the Laboratory of Structural Biology & Molecular Medicine, the Crump Institute and the Division of Nuclear Medicine (all of which are headed by

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CHCPP NEWS
COMMISSION ON
HEALTH CARE POLICY AND PRACTICE

CHCPP Update: HCFA Policy on Ordering Diagnostic Tests

SNM recently contacted Terrence Kay at the Health Care Financing Administration (HCFA) to inquire about ordering diagnostic tests. In part, that letter read:

HCFA published policy and comments on "Ordering Diagnostic Tests" in its June 18, 1997 and October 31, 1997 rules. In response to SNM's June 1997 comments, HCFA's October 31, 1997 rule stated that "in order to address these concerns more fully, we would need more specific information as to the state and federal regulations in question." SNM's October 1997 comments responded to this request for regulatory information; however, this issue was never addressed or clarified in the 1998 proposed or final rules.

Members of our organization have contacted us recently to inquire about ordering additional diagnostic tests (e.g. chest x-rays) when indicated. We are unable to respond to these inquiries because we have never received a definitive response from HCFA on this issue. To the best of my knowledge, HCFA has never addressed our specific comments regarding the October 1997 rule.

Kay replied on April 20, 1999 as follows:

I am responding to your letter... regarding the requirement that diagnostic tests payable under the physician fee schedule be ordered by a physician or nonphysician practitioner who is furnishing a consultation or treating the beneficiary for a specific medical problem. There is no requirement that the order be in writing (except in the case of an independent diagnostic testing facility), and there is no requirement that the carrier verify the existence of such an order before making payment. Further, neither the rule itself nor the preamble discussion precluded coverage of the performance of additional testing by the radiologist, nuclear medicine or other physician as long as the ordering physician is notified of the additional testing.

We feel that we did address your comment in the October 31, 1997 final rule by indicating that we did not fully understand your concern. We would like more specific information about the State and Federal regulations which preclude anyone other than a nuclear medicine physician from ordering nuclear medicine procedures. This would be helpful for us to determine whether further revision of our regulations for diagnostic testing is needed.

Otherwise, we believe that your suggestion would eventually have to be extended to everyone and would, in effect, make the ordering requirement meaningless. Finally, it would be helpful to know of any instances in which your members are being denied payment inappropriately for their services because of this requirement.

Integration

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Phelps) will receive a combined total of more than $20 million in research funding this year compared to $7 million in funding six years ago.

If awards are any measure of success, Phelps's department is among the most successful in nuclear medicine. Lou Ignarro, PhD, a faculty member in the department, won the Nobel Prize this year and was elected this year, along with Phelps, to the National Academy of Sciences. Phelps also won the 1999 Enrico Fermi Presidential Award, the highest and oldest science and technology award given by the United States government, for his invention of the PET scanner. "Also, two of the largest selling drugs, Viagra and the COX-2 inhibitors, were developed based on discoveries made by two faculty of the department, Drs. Ignarro and Herschman, respectively," said Phelps.

While conceding that most nuclear medicine programs are not headed for the dramatic change that his department underwent, Phelps emphasized that integration will play an integral role in nuclear medicine. "The concept of biological imaging is growing, and I believe it will become a new discipline in biological sciences," said Phelps. "I also believe that biological imaging examinations of patients that stem from this research will continually be building the future of nuclear medicine."

Reaching Out to Other Specialties

Other research institutions throughout the country have created integrated nuclear medicine departments, albeit in a less formalized way than the department at UCLA. "At Sloan Kettering, we take a team approach, and our nuclear physicians have close contact with other specialists who are quite open to new ideas," said Homer Macapinlac, MD, clinical director of the PET facility at Sloan Kettering. Every cancer patient is treated via a team approach that involves weekly meetings among the nuclear physician, surgeon and medical oncologist. "We also give nuclear medicine seminars in areas such as lymphoma, melanoma and breast cancer that are well attended by the oncologists," Macapinlac said. Moreover, each of the five nuclear physicians on staff has a special interest area such as head and neck cancer, whole-body PET imaging or monoclonal antibody therapies. "Our nuclear physicians have liaisons with the disease management group in each of our specialized areas," Macapinlac said. "We are getting constant feedback about our procedures that allows us to keep the relationship going and to give them what they need to deter-

mine treatment for their patients."

While it is true that nuclear physicians who work at a cancer center may have an easier time integrating into a specialty beyond nuclear medicine, nuclear physicians at broader-based hospitals can still apply the techniques used at Sloan Kettering to their own practices, according to Macapinlac. For instance, a nuclear physician can focus on sports medicine and set up a team with orthopedics, while another can focus on cardiology and create links with the cardiac care unit. In fact, Wagner takes this concept one step further: He said he believes that the disintegration of the traditional nuclear medicine department and the integration of nuclear medicine into various specialties could be a very real possibility in the next millennium, at least at some institutions. "A nuclear oncologist would have an oncology practice and also perform lymphoscintigraphy, just like a nuclear cardiologist sees cardiac patients and performs perfusion imaging," he said.

Most nuclear medicine leaders believe, however, that nuclear medicine will remain a separate entity unto itself with nuclear physicians maintaining broad-based practices in nuclear medicine or radiology. Still, the growing number of uses for nuclear medicine in molecular imaging has ignited an excitement among physicians outside the nuclear medicine field. "The understanding and knowledge of PET among referring physicians has increased dramatically over the last year or two," said Coleman. He has experienced a significant increase in referrals for PET procedures, especially after Medicare began to cover PET for certain indications. "Our department experienced a 30% increase in PET procedures from 1997 to 1998, and we expect the increase to continue this year," said Coleman. He said he expects his department to perform more than 2000 PET scans this year, compared to 1600 scans last year and 1200 scans in 1997. Although nuclear physicians perform the scans and process all the data at Duke, researchers from various specialties have recently become more well-versed in the intricacies of PET, according to Coleman. "However, I don't see integration of nuclear medicine with other specialties at this point," he said.

Only time will tell whether integration is indeed the wave of the future. For the present, nuclear physicians can use one simple assessment to determine whether their own discipline has become more integrated: Where is it located? "Our department is located in a busy section of the hospital, not in the basement away from everyone," said Macapinlac. "Referring physicians want us in a convenient location, so they can drop in on a regular basis and see our scans."

— Deborah Kotz

SNIDD

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two of the first eight commercially produced small-animal PET scanners, which are copies of the prototype scanner developed by Cherry's research group (see Chatziioannou et al., "Performance Evaluation of microPET: A High-Resolution LSO PET Scanner for Animal Imaging," in this issue).

"We originally built the prototype as a physics challenge without really appreciating the wide range of applications. We now find we need a second system here at UCLA because the small-animal scanner has become our most heavily used PET machine," said Cherry. An anticipated dividend of commercializing micro-PET that SNIDD emphasizes is that the technology will provide a seamless transition from preclinical pharmacologic studies to phase I trials , said McCarthy. "At the early stage in drug development, compounds are evaluated in small animal models. In many cases, these compounds may behave differently in higher species. PET provides an opportunity to determine if these problems exist before developing a compound further. Put another way, tremendous cost savings can be realized by being able to make early decisions about a lead compound's suitability for further development."

Another anticipated benefit is that micro-PET will provide more sophisticated ways to utilize the many transgenic mouse models of disease that have become central to the drug development process, said Cherry. "With micro-PET, we can repeat the same study on a single mouse, which allows us to do very useful things such as monitoring the biochemical response to drugs as a function of time. In the future we also believe that we will be able to monitor gene therapy with PET, providing us with a tool to assess new molecular therapies. Continued improvements in PET spatial resolution will in a year or so allow for more precise measurements of the biologic effects of drugs on particular sets of cells in the mouse. Perhaps within five years these capabilities will be further enhanced by building complete micro-PET systems within CT or MRI machines in order to combine precision functional and anatomical imaging."

Lack of communication and the current limitations of nuclear imaging modalities are not the only challenges SNIDD faces in forging industry-academic partnerships, said Frank. "The international pharmaceutical industry has recently concluded, very significantly, that no drug company can singularly own the new imaging modalities. Rather, these technologies will remain in the public domain and drug companies will compete on a drug-by-drug basis. Still, the proprietary nature of molecules and imaging systems patented by a pharmaceutical company will have to be considered by its academic partners who want access to these resources." Another challenge, added McCarthy, will be to try to standardize the way in which validation studies of new radiopharmaceuticals are carried out among the radiopharmaceuticals research community.

—Jill Katz