Southeast Asia: The IAEA's role in training nuclear medicine professionals

A look at priorities and possibilities

by J. Morris

Above: Sketch of a nuclear medicine researcher at the Australian Nuclear Science and Technology Organization. (Credit: ANSTO)

It is now some two decades ago that early versions of nuclear medicine procedures became firmly established in the Southeast Asian region. Since then, there has been steady progress. To this day, diagnostic procedures, the supply of radiopharmaceuticals, and the standard of imaging equipment have all kept pace with similar developments in other parts of the world. These developments were greatly assisted by nuclear medicine training schemes, most of which were either fully organized and financed by the IAEA or were strongly and effectively supported by it.

Scientific medicine does not stand still. The manifold requirements of nuclear medicine departments in Southeast Asia continue to change rapidly as they do elsewhere. Today it is as important as ever to agree on appropriate training policies which are capable of being implemented effectively and with minimum delay.

Dr Morris is Director, Department of Nuclear Medicine, Royal Prince Alfred Hospital, Camperdown, NSW, Australia. This article is based on proposals he made during Working Group meetings under the Regional Co-operative Agreement (RCA) of the IAEA that took place in Chiang Mai, Thailand, in August 1990.

What can and cannot be bought

Steady support from governments and international agencies, principally the IAEA, have ensured that instruments could be updated whenever improved models were offered, and that money was available for the purchase of the most recently developed radiopharmaceuticals.

In contrast, trained, experienced, and dedicated personnel could never yet be bought "over the counter". To identify, recruit, train, and retrain such people is not only a matter of money: it cannot be done without thoughtfully and competently arranged training schemes. The IAEA has been aware of these needs, as noted earlier, and nuclear medicine departments in Southeast Asia look forward to continued support. Such support is needed in departments that undertake teaching tasks, just as much as they are in departments that wish to benefit from training opportunities.

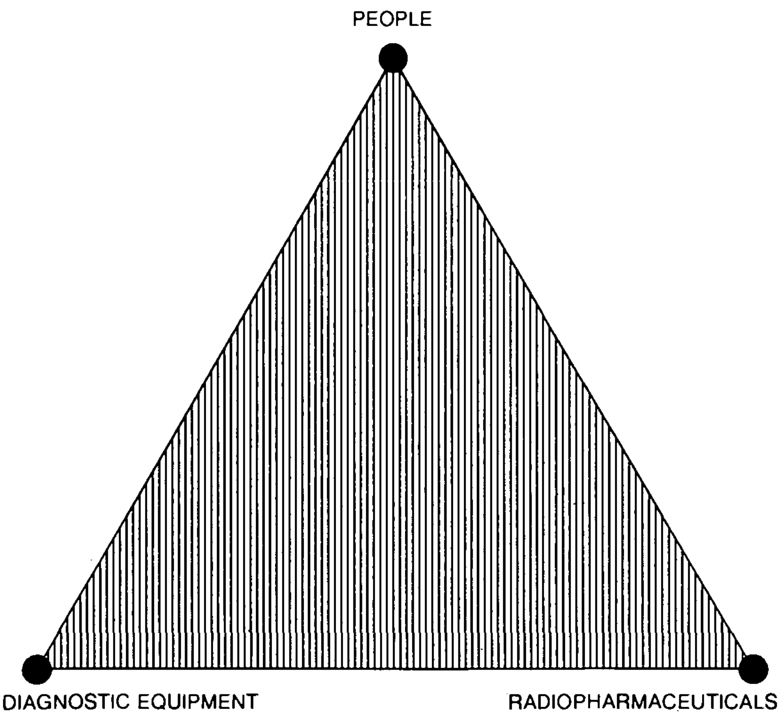
This article identifies priorities and makes recommendations with respect to training schemes likely to be appropriate for this region. Based on experience gained in Australia and what we observed overseas, there are two points which have to be borne in mind: 1) how to provide, in each country of the region, the best nuclear medicine services maintainable under the given conditions; and 2) the need to undertake all training schemes, being consciously aware of the circumstances that have made nuclear medicine a uniquely valuable diagnostic modality which is both clinically effective and cost effective.

Training needs and what to do about them

How nuclear medicine is employed to overcome diagnostic problems varies from country to country. Most problems are being met using general purpose equipment: the basic, computer-equipped gamma camera. This is an exceedingly versatile instrument. What is required to use it effectively are the relevant labelled compounds, and, of course, thoroughly well-trained personnel. Given these preconditions, it is almost always possible to obtain at least some useful information for all organs and diseases which, more often than not, could not be obtained in other ways.

While instrumentation continues to evolve at a steadily accelerating pace, this is not so as regards the dissemination of the knowledge needed to exploit these technologies to the fullest. Centres have been provided with complex equipment but with little or no support or instruction. Not surprisingly, they then often failed to extract the benefits which would have been obtained by more knowledgeable staff.

Regular communications and interaction between centres in our region is crucially important if nuclear medicine expertise is to emerge and thrive. Recent training sessions on computer applications in nuclear medicine organized jointly by the Department of Nuclear Medicine at the Royal Prince Alfred Hospital and the Australian Nuclear Science and Technology Organization (ANSTO) have demonstrated that resources exist within the region which would ensure that training schemes could be implemented in a co-ordinated way. But to mobilize resources efficiently, one has to make sure that training periods are sufficiently long to cope with the complex material which students have to master. This applies for physicians as well as for physicists, radiopharmacists, engineers, and nuclear medicine technologists. The lead time for training the most vital resource — people — is now unavoidably longer than it used to be. It is this fact which is behind the demands for longer and more carefully organized training periods than appeared adequate in the past, a demand which is strongly supported within the Department at the Royal Prince Alfred Hospital.



The nuclear medicine triangle

The current situation may be usefully summarized employing a triangle. The triangle symbolizes the mutual interdependence of the three components contributing to each nuclear medicine procedure: highly trained staff, radiopharmaceuticals, and diagnostic equipment, including computing hardware and software.

The entry "PEOPLE" is shown at the apex of the triangle. They are the resource that is most difficult to bring together. They have to be recruited from the small fraction of the population with the required high ability. They have to undergo lengthy training periods while retaining their enthusiasm and dedication. This can be done. If it were not so, nuclear medicine would not be as powerful a diagnostic tool as it is. But it is far from easily done and it is getting more difficult from year to year.

At the corners along the triangle's base are the radiopharmaceuticals and the diagnostic equipment. These are items bought over the counter. Still, the purchase is only the beginning of the task. Purchases remain of limited value unless selected and employed by thoroughly well-trained people at the triangle's apex. It is then and only then that the radiopharmaceuticals, the diagnostic equipment, and its computer-assisted output can become clinically effective and cost effective.

Of course, there is also the very valuable input from the staff of the suppliers. They, too, make contributions which have to be of the highest quality, and it would be churlish to overlook this. Still, unless the nuclear medicine staff has been sufficiently well trained to make proper use of the radiopharmaceuticals and the various types of imaging equipment, the final result will fall well short of what it could and should be.

What does nuclear medicine offer?

It is the satisfactory answer to the question of what nuclear medicine offers that has justified the IAEA's strong support of nuclear medicine in the past and its continuing future support. To conclude this article, I offer a brief outline of some of my thoughts on this important question.

Effective treatment of the major causes of mortality and morbidity depends on diagnostic techniques which demonstrate early changes in biochemistry and blood flow. Chemical disturbance is often the first indication of a disease process and its early demonstration greatly increases the chance of cure. Nuclear medicine is uniquely able to provide information on such a disturbance directly and non-invasively.

All nuclear medicine diagnostic techniques involve the introduction of a minute amount of a radiolabelled pharmaceutical tracer into the patient and the visualization of its subsequent fate. The development of suitable detection instruments for these visualizations, and computerized data collection and analysis techniques, have allowed the exactness and repeatability of laboratory *(in vitro)* biochemistry to be extended to kinetic body measurements *(in vivo)*. This external, non-invasive study of chemical changes in the body enables contemporary nuclear medicine to play its unique role in the early diagnosis of the major diseases in the population, notably heart attacks, stroke, and cancer.

The impact of nuclear medicine has been heightened by the introduction of the medical cyclotron. This powerful instrument with its associated biochemical laboratory — much of it computer-controlled — represents the cutting edge of radiopharmaceutical design. Thanks to the availability of such radiotracers as carbon-11, nitrogen-13, oxygen-15, and fluorine-18, positron emission tomography (PET) cameras are providing powerful diagnostic tools. Its emerging clinical applications include, among others:

- ***Measurement of myocardial viability.*** PET is at present the only exact technique for demonstrating injured but salvageable heart muscle. The data accumulated by PET studies are crucially important in determining the most appropriate site for coronary artery bypass graft (CABG) surgery, and in selecting those patients who require CABG or heart transplants.
- ***Brain tumours, epilepsy, stroke, and dementia.*** These can now be diagnosed and managed much better than formerly by demonstrating the exact site and degree of abnormal biochemical activity. This is done in three dimensions with the tomographic capabilities of single photon emission computer tomography (SPECT) and PET.
- ***Detection and measurement of cancer response to treatment.*** This can be demonstrated very soon after administration of chemotherapy or radiation. The rapid decline of tumour metabolism following treatment can be promptly demonstrated with PET using glucose labelled with fluorine-18 as the tumour metabolism marker.

At present, these valuable investigations rely on highly expensive PET techniques. Yet the large majority of departments in the Southeast Asian region would not be in a position to use these techniques until costs decrease substantially. It appears to be possible to translate many of the just quoted advances pioneered with the PET technique for use with the much more widely available SPECT techniques. One could then use technetium-99m and iodine-123 "equivalents" of PET radiopharmaceuticals. It would be almost certainly unnecessary to install PET cameras and cyclotrons in more than a few hospitals, strategically located in centres involved in advanced research.

In conclusion, let me return to the PET techniques, and the problem of training highly competent staff. It must be clearly realized that it is the inadequate supply of experienced staff which currently limits the rate of nuclear medicine applications. Given the long lead times for recruitment and training, it is essential that all interested parties act without delay to ensure that recruitment and training are maintained at a sufficiently high level.