A CAREER IN NUCLEAR MEDICINE

John Frank explains why Nuclear Medicine has become a major dynamic imaging speciality

Nuclear Medicine is that branch of imaging that uses radio-isotopes to study the physiology and metabolism of the body rather than anatomy demonstrated by x-rays, CT, ultrasound and MRI. Nuclear Medicine today is the exciting development of the early 20th century pioneering work of, among others, Rutherford, the Curies, and Lawrence, who built the first cyclotron in 1933. With all the new isotopes and radiopharmaceuticals becoming available, there is a huge scope for advances in the field. If you would enjoy the personal and intellectual challenge of working in a rapidly developing multi-craft speciality, then you may be a candidate for a Nuclear Medicine NTN. It also helps to be computer literate! There have been many recent advances in Nuclear Medicine, and without doubt the most exciting is the development of PET imaging, and particularly PET/CT. This has revolutionised Oncological imaging, and ideally no major cancer centre should be set up without PET.

Today, Nuclear Medicine encompasses a wide range of investigations and therapies.

<table>
<thead>
<tr>
<th>Box 1: The scope of Nuclear Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIAGNOSTIC</td>
</tr>
<tr>
<td>Bones and joints</td>
</tr>
<tr>
<td>Cardiac</td>
</tr>
<tr>
<td>Lungs</td>
</tr>
<tr>
<td>Endocrine</td>
</tr>
<tr>
<td>Gastroenterology</td>
</tr>
<tr>
<td>Renal</td>
</tr>
<tr>
<td>Neurology</td>
</tr>
<tr>
<td>Oncology</td>
</tr>
<tr>
<td>DEXA</td>
</tr>
</tbody>
</table>

As the discipline is essentially non-invasive, it correlates well with all other forms of imaging. We can show the activity of disease rather than the anatomical appearance, such as in Crohn's where the barium enema will show what the bowel looks like, but the labelled white cell scan will show the extent of activity. Such an ability offers a crucial service to the clinician. There is therefore a huge interaction with the rest of imaging, the clinicians and the oncologists.

You can also become involved in the therapeutic aspects of Nuclear Medicine, both curative as in the treatment of thyrotoxicosis with 131I, neuroendocrine tumours with yttrium and 131I, and palliative as in the administration of strontium or samarium to alleviate pain from bone metastases. In many centres, treatment of thyrotoxicosis with radio-iodine is the preferred option, and has excellent results. Nuclear Medicine therapy offers the possibility to selectively target neuroendocrine tumours such as carcinoid, and research is continuing to label specific monoclonal antibodies to a variety of tumours both for diagnosis and therapy.
Nuclear Medicine scans can be either static or dynamic, thus showing differing aspects of the body's function.

**Box 2: A typical week in Nuclear Medicine**

- Reporting all types of scans
- Carrying out cardiac stress studies
- Pre-therapy clinics for thyrotoxic patients and other therapies
- Therapy administration, eg radio-iodine
- Taking part in MDTs
- Teaching
- Research and development
- Other hospital committee work
- Possibility of continuing radiology and/or general medicine work

**Box 3: Examples of some different types of scans**

<table>
<thead>
<tr>
<th>STATIC</th>
<th>DYNAMIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone</td>
<td>MAG3 renal</td>
</tr>
<tr>
<td>Thyroid</td>
<td>Cardiac</td>
</tr>
<tr>
<td>Lung scan</td>
<td></td>
</tr>
<tr>
<td>DMSA renal</td>
<td></td>
</tr>
<tr>
<td>PET</td>
<td></td>
</tr>
</tbody>
</table>

**SOME PICTORIAL EXAMPLES**

[Images of nuclear medicine scans]
This lung scan shows multiple perfusion defects with normal ventilation, typical of pulmonary emboli in both lungs.

The bone scan on the left is normal in comparison with the one on the right which shows multiple metastases, invisible on a conventional x-ray.

This is a thyroid scan in a patient with Graves disease.

This example of a MAG3 dynamic renal scan shows the uptake and clearance of tracer by the kidneys, and demonstrates obstruction on the right.
This is a PET image showing intense activity in the mid-oesophagus in a patient with an oesophageal ulcer seen on endoscopy, later proven to be carcinoma of the oesophagus.

This is a PET image of a carcinoma of the right bronchus.

There is no doubt that the future lies with PET scanning. PET (positron emission tomography) uses $^{18}$F labelled fluorodeoxyglucose, a glucose analogue, to map the metabolic function of cells. This, when combined with modern CT, gives a most powerful weapon in the staging of malignancy.

PET is also useful in cardiac imaging to define hibernating myocardium, and in neurological imaging, particularly of dementia.
JOB APPEAL AND SATISFACTION

For all the reasons I have given, there is enormous job satisfaction in Nuclear Medicine. I have summarised this here.

Box 4: Appeal of Nuclear Medicine

- Intellectually very satisfying as part of a multi-craft team
- Intensive work
- Good correlation with radiology and general medicine
- Research involvement in all studies requiring an ARSAC licence
- Friendly colleagues within Nuclear Medicine world
- Job sharing possible
- Good work/life balance

The satisfaction comes from making the diagnosis, especially where unclear clinically, as in the case of pulmonary embolism, and thus altering the patient's treatment for the better.

Nothing beats letters of thanks from patients you have helped or cured.

TRAINING IN NUCLEAR MEDICINE

An ARSAC licence is required before any Nuclear Medicine investigations can be performed, and to obtain an ARSAC licence, you must show proper training in Nuclear Medicine. ARSAC, or the Administration of Radioactive Substances Advisory Committee, is a governmental body which ensures that your training will be adequate to allow the Minister of Health to issue you a licence to administer radioactive substances. This indicates that you are a suitable person to run and control a Nuclear Medicine department, and also meet the IR(ME)R regulations criteria.

Although currently there are relatively few funded NTNs, more are being created all the time, especially in conjunction with radiology where the subspecialty training in Years 5 and 6 now allows trainees to specialise in Nuclear Medicine.

There are two pathways to train in Nuclear Medicine. Both may lead to the CCST in Nuclear Medicine.

The first, aimed at radiologists who hold the FRCR, is to take Year 5 of the specialist registrar training scheme in Nuclear Medicine. This will allow the radiology registrar to obtain recognition in Radionuclide Radiology, but does not lead to a CCST in Nuclear Medicine. It does, of course, count towards the CCST in Radiology. Year 5 work covers all aspects of nuclear medicine imaging with the exception of PET. For dual accreditation, Year 6 must also be spent in Nuclear Medicine, and during this year, experience will be gained of in vitro work, PET and therapy for both benign and malignant disease. If you take the two year option, then you will finish with dual accreditation in Radiology and Nuclear Medicine, and can also study for the M.Sc in Nuclear Medicine during years 5 and 6. At the moment this course, which is part time over two years, is run from King's College in London. Year 5 is run under the auspices of the Royal College of Radiologists, but Year 6 is controlled by the Royal College of Physicians of London.
The second pathway, aimed at physicians who already hold the MRCP, takes four years and is made up of theory and clinical work based at an accredited centre. As well as diagnostic work, the course also covers laboratory work, PET and therapy with unsealed sources, both for benign and malignant disease. The CCST is awarded at the completion of training, and this allows the acquisition of an ARSAC certificate, both for diagnostic and some therapy work. This whole course is run under the aegis of the Royal College of Physicians of London. During the four years, you can also study for the M.Sc in Nuclear Medicine.

If you are a radiology trainee who wishes to be considered for further training in Nuclear Medicine, you will need to discuss this with the Consultants in Nuclear Medicine and your College tutor, so that you can be assessed for suitability for Year 5 training. If during this year you decide that you would like dual accreditation and so do Year 6, you will need to discuss this further with the Nuclear Medicine Consultants. You must also look out for advertisements in the BMJ, as under current regulations the Year 6 posts must be advertised nationally, and an assessor from the Royal College of Physicians sits on the interview panel.

If you are a physician who wishes to specialise in Nuclear Medicine, then you should discuss the prospects of training in Nuclear Medicine with your local Nuclear Medicine Consultants and your RCP College tutor, and also look for the advertisements for posts in the BMJ. The BNMS website, where details of all the trainee posts and NTN status is recorded, is of great help to all potential trainees.

**CAREER PROSPECTS**

These are good. The Intercollegiate Standing Committee on Nuclear Medicine carried out a survey which was published earlier this year, and indicates that between 100 to 120 Consultants with Nuclear Medicine training will need to be replaced over the next ten years. In addition, as more departments expand and the provision of PET and CT/PET becomes a greater possibility, new posts will be created.

There are two main types of Consultant in Nuclear Medicine. If you are a Physician-trained Consultant, you will mainly work in larger centres, either purely in Nuclear Medicine or also with some general medical responsibility. If you are a Radiology trained Consultant, and have just done Year 5 in Nuclear Medicine so that you are eligible for an ARSAC licence, you would be a radio-nuclide radiologist with a CCST in Radiology. You would tend to work in DGHs as a radiologist but also have responsibility for all the Nuclear Medicine there. You would probably only devote 4 sessions/week to Nuclear Medicine. If, though, you have done Year 6 as well and have dual accreditation, then it is more likely that you would work in a larger hospital where the Nuclear Medicine department is separate from radiology and spend most of your time in Nuclear Medicine, with only a couple of sessions a week in radiology.
THE FUTURE

This is bright and good for Nuclear Medicine specialists. Without doubt, the future is CT/PET, as cancer and oncology enjoy a high priority. Nuclear Medicine can and does play a vital role in both diagnosis and therapy, and you can be part of it. Plan to visit your local Nuclear Medicine department, talk to the staff there, and see if you have what it takes!

Dr John Frank  Consultant in Nuclear Medicine and Radiology  Charing Cross and Hammersmith Hospitals, London W6 8RF  jfrank@hhnt.org

FURTHER READING AND INFORMATION

Prvulovich EM and Bomanji B: The role of Nuclear Medicine in Clinical Investigation, 1998 BMJ, 316, 1140-1146 (April).


ARSAC Committee - Notes for Guidance on the Clinical Administration of Radiopharmaceuticals and Use of Sealed Radioactive Sources, December 1998

USEFUL WEBSITES

British Nuclear Medicine Society - www.bnms.org.uk
Royal College of Radiologists - www.rcr.ac.uk
Royal College of Physicians of London - www.rcplondon.ac.uk
Society of Nuclear Medicine - www.snm.org
European Association of Nuclear Medicine - www.eanm.org

ARSAC - part of the NRPB, and can be contacted by telephone 01235 834925

ACKNOWLEDGEMENTS

Some of the images are from a forthcoming book 'Get through Nuclear Medicine for the FRCR and MRCP' by J W Frank, T O Nunan and J Young, to be published later this year by RSM Press.