EANM
European Association of Nuclear Medicine

Best Practice in Nuclear Medicine

Part 1

A Technologist's Guide

Sponsored by
Bristol-Myers Squibb
Medical Imaging
Innovators at Heart

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Foreword

Sylviane Prévot

One of the major achievements of the EANM Technologist Committee in the past 2 years has been the publication of a series of brochures "Technologist's guides" that was initially planned with two main goals: to encourage Nuclear Medicine Technologists' (NMTs) reflection on the quality of their daily practice and to advance it if necessary.

The aim of this third volume is to provide an introduction to best practice in Nuclear Medicine considering three main items : management of a modern day Nuclear Medicine service, clinical guidelines & protocols, management of human resources. The impact of policy and legislation on best practice will be the purpose of a second part to be published at the EANM Congress 2007 in Copenhagen.

I am grateful for the efforts and hard work of all the contributors, who are the key to the content and educational value of this booklet. The most essential and relevant aspects of best practice are emphasized here. Many thanks to Suzanne Dennan for her dedication to the success of this guide. This publication wouldn't have been possible without Bristol-Myers Squibb Medical Imaging support. Their collaboration and generous sponsorship was greatly appreciated.

Quality is not just a nice concept : quality is a state of mind. I hope this brochure will meet the expectations. Contributing to the quality assurance of Nuclear Medicine practice it may also become a useful tool for motivated technologists in the optimization of the overall quality of healthcare in Europe.

Sylviane Prévot
Chair, EANM Technologist Committee

Introduction

Ignasi Carrió M.D.

Nuclear Medicine departments offer a large diversity of diagnostic and therapeutic procedures, which often play a central role in patient management. At the same time, the field is constantly evolving with new procedures being continuously introduced. In such a rich and developing scenario, adherence to best-practice guidelines becomes crucial to offer best patient care.

Nuclear Medicine technology is a demanding and sophisticated profession. The continuous developments in technology, radiopharmaceuticals, procedures and patient care make it one of the most rapidly evolving health care professions. For example, novel targets for imaging have emerged, such as labelled glucose for the imaging of cancer, labelled somatostatin tracers for the imaging of neuroendocrine disease, beta CIT homing onto the dopamine transporter for the investigation of patients with movement disorders. Progress is coming in the imaging of the Alzheimer's disease, the imaging of atherosclerotic plaque and the imaging of angiogenesis and hypoxia. Sentinel lymph node detection has changed the surgical management of patients presenting with early breast cancer. At the same time, all diagnostic procedures have benefited from major progress in instrumentation; and in the last 5 years, the emergence of multimodality imaging has become routine. Conventional gamma cameras have been linked to advanced CT scanners (SPECT/CT) and modern PET scanners have been linked to multi-slice CT devices (PET/CT).

Nuclear Medicine therapy has also been growing far beyond the established treatment of benign and malignant disease of the thyroid. I-131 when linked to metaiodobenzylguanidine is used in the treatment of neuroendocrine malignancies, such as pheochromocytomas and neuroblastomas. Newer ligands targeting the SS2 receptor subtypes are emerging, labelled with Yttrium 90, Lutetium 177 and other radionuclides. Pain palliation in advanced metastatic and skeletal prostate and breast disease has become available, with one third of patients showing excellent response to a variety of radionuclides, including strontium 89-chloride, rhenium-186 as etidronate, samarium-153 as ethylene-diaminetetramethylene phosphonate. Several labelled antibodies have been entered in clinical trials and some have now been approved as specific treatment options, such as Zevalin or Yttrium-90 labelled ibritumomab tiuxetan and Bexxar – I-131 labelled tositumomab.

With such continuing developments and innovation, best-practice may become a moving target. Clearly, best-practice guidelines must be developed and implemented at the European level that help Nuclear Medicine departments to provide best patient care. Updated procedural and clinical guidelines are available from the EANM website for many of the well established diagnostic and therapeutic procedures. Adherence to such guidelines is highly desirable to harmonize patient care across the diversity of European countries. Eu-

ropean Nuclear Medicine technologists practice Nuclear Medicine in departments where most of these procedures are performed in a patient's diagnosis or follow-up. As members of their institutional health care team, they also function as patient advocates, educators, health care researchers, technical and therapy specialists, and interdisciplinary consultants and play a key role to offer best clinical practice. Nuclear Medicine must embrace the principles of best-practice as the basis for clinical judgement, within the context of working as part of a multi-disciplinary team in medical diagnosis and therapy. Within such multi-disciplinary teams, Nuclear Medicine technologists must play a leading role in establishing clinical standards and clinical protocols.

In order to offer best practice, continuing education is essential. The education process in Nuclear Medicine includes graduating from an accredited programme, completing a summary of clinical competence and completing a professional certification examination when available. The education process assures that Nuclear Medicine technologists have the knowledge, skills and judgement to be competent health care providers in their highly specialized discipline. In addition, lifelong learning is a core value for all health care professions. Therefore, entry-level education in Nuclear Medicine must be supported by both formal and self-directed professional development programmes. All these programmes, including cognitive, affective and clinical competence, must be part of best-practice codes in any Nuclear Medicine department.

Like all healthcare professions, Nuclear Medicine must move with the times, changing and adapting its principles and relationships, acknowledging the expectations of patients and the developing practice of other healthcare disciplines. Like all healthcare professions, only by understanding, accepting and adapting to these changes can Nuclear Medicine offer best-practice and retain its relevance within medicine and society.

Ignasi Carrió, M.D.
President, EANM

Section 1 – Managing a Nuclear Medicine Service

1.1. Patient Workflow and Efficient Scheduling

Anil Vara

Introduction

An efficient Nuclear Medicine department relies mainly on good scheduling of patients for an efficient workflow. Nuclear Medicine has various types of examinations, each with its own time scale, preparation, and various complications. Diagnostic imaging is the most common type of examination most centres schedule routinely.

Diagnostic Imaging

Diagnostic imaging makes up the bulk of examinations in Nuclear Medicine. Efficient scheduling for this is mainly dependent on staff availability, gamma camera numbers, and gamma camera types. Some centres may operate with a single gamma camera, whilst some departments may have multiple gamma cameras at their disposal.

Table 1: Example outline of a day list illustrating flexibility in Nuclear Medicine exam type. Courtesy of Kingston NHS Hospital, Surrey; Vara 2001

TIME	STUDY	PATIENTS NAME	COMMENTS
09:00	URGENT BONE		
09:15/09:30	RBC/MECKELS/MAG3		
09:45			
10:00	BONE/DMSA INJ 1		
10:15			
10:30	LUNG PERFUSION		
10:45	BONE/DMSA INJ 2		
11:00	BONE/DMSA INJ 3		
11:15	BONE/DMSA INJ.4		
11:30	3 PHASE BONE 5		
12:00	3 PHASE BONE 6		
12:15	URGENT BONE SCAN		
13:00	BONE/DMSA SCAN 1		
13:45	BONE/DMSA SCAN 2		
13:45			
14:00	BONE/DMSA SCAN 3		
14:15			
14:30	BONE SCAN 4		
14:45			
15:00	BONE SCAN 5		
16:30	BONE SCAN 6		

One Gamma Camera Department

Centres that have only one gamma camera are most likely to schedule various types of examinations during a working day. Careful planning and organisation is critical to achieve this, in light of the complexity involved in various Nuclear Medicine exams. Block booking particular exams could be difficult to achieve, whilst having the flexibility for all types of exams over a working day would be more efficient. Table 1 illustrates an example of a typical day's workflow on a single gamma camera.

The outline of the example takes account of the various camera times required for each exam, whilst fully utilising all the capacity available to schedule the various exams. This type of day diary can be easily set up for single camera departments, but care must be given on examinations that are higher in demand. Systematic review of all workflows should take place regularly, especially following a protocol review.

Multiple Gamma camera departments

Scheduling on multiple gamma cameras can be flexible, but the main advantage is that block booking of particular exams can be achieved more efficiently than in single camera departments. The option of block booking for higher demand studies, for example Myocardial Perfusion studies such as Octreotides or MIBG can be better streamlined, not hindering 'common' types of work such as Bone scanning etc.

Other types of examinations

Scheduling non-imaging examinations alongside diagnostic imaging is needed in most Nuclear Medicine departments. These could be exams such as GFR, red cell mass or therapeutic administrations. In-vitro based exams are mainly performed by trained staff that are commonly multi-tasking and involved in other areas. Rotating staff through all areas maximises expertise and is best for flexibility in scheduling non-imaging work alongside diagnostic imaging. Scheduling in-vitro work has to be carried out with care to ensure adequate capacity is maintained at all times in all areas of the department.

Therapy is very dependent on key professionals such as consultants and/or medical physicists. Usually in this case, scheduling of these patients is independent of other Nuclear Medicine work, but attention is needed if technological staff have delegated responsibility in Therapy.

Section 1 – Managing a Nuclear Medicine Service

1.2. Stock Control

Anil Vara

Introduction

Stock control in Nuclear Medicine is an essential task for the efficient operation of the Nuclear Medicine department.

The types of stocks routinely handled are:

1. Radiopharmacy consumables
2. Clinical consumables
3. Pharmacy consumables
4. Administrative consumables

1. Radiopharmacy Consumables

Radiopharmacy consumables include cold kits, nuclides and items used for radiopharmacy production. Cold kits have to be carefully managed, as their requirement is very much dependent on the particular demands for certain types of examinations, which can vary over quite short periods of time. Most centres have purpose built databases or spreadsheets for managing these stocks. These are usually for the purpose of recording incoming stock and auditing the level of use based on the service need. Such databases allow a concise record allowing all aspects of stock control to be monitored but there is still an element of good communication needed between the production service and the diagnostic service to reduce the occurrence of overstocking and to accommodate any service changes. When ordering cold kits and ^{99m}Tc generators, this is best accomplished by a standing order with the supplier, but a regular stock take every month is essential in conjunction with this, in order to minimise costs and waste. Commercial companies are now offering software packages to carry out the overall management of radiopharmacy stock, with options built in to warn of low stock levels and automatic updating.

Ordering long-lived radiopharmaceuticals such as ^{111}In Octreotide, I^{131}MIBG etc. is usually carried out on a per usage basis.

2. Clinical Consumables

Clinical consumables range from frequently consumed items such as syringes, needles, gloves, sharps bins etc to items that are used less frequently such as, ventilation kits for aerosols, specialised nursing aids etc.

The golden rule is not to overstock on these items, which is a common practice in some Nuclear Medicine departments. This can lead to excess requirement for storage space, the risk of items expiring and of accumulating unused items which would incur costs. Commonly, these types of stocks are controlled and ordered as a common pool with other modalities such as Radiology and CT. By averaging out consumption, this does achieve an adequate stock of clinical consumables which can be reviewed weekly or every fortnight. Most hospitals operate an online ordering system, direct to their stores and even set up standing orders. Standing orders would be practical for consumables that have average usage (per week for example) and the average usage is sustained.

3. Pharmacy Consumables

Nuclear Medicine routinely has to stock both drugs that are commonly used as part of the examinations and essential drugs which are used for intervention when faced with emergencies. Usually a standing order with the pharmacy department would be best to manage the incoming stock of drugs with the advantage of cross charging made easier to budget for every month. Additional drugs can be requested when stock is low. The most crucial element is that pharmacy drugs are all checked for expiry regularly and that drugs used should be replaced as soon as possible. In these cases, it is often useful to stock take once or twice a week so the drugs cabinet is not in surplus and that all essential drugs are in stock.

4. Administrative Consumables

These consumables are essential for the efficient clerical operation of Nuclear Medicine. Again overstocking could result in unnecessary costs to the department. The common practice for most institutes is that administration consumables are managed by a central department, which is usually also covering many modalities other than Nuclear Medicine. Increasing turnover in this way, it can be ensured that stock is well controlled and that surpluses do not occur.

1.3. Cost Implications – Budgeting

Anil Vara

Financial pressure is always a concern for an efficient operation of a Nuclear Medicine service, usually associated with overall Health/Trust service pressures. It is important to manage the departmental budget properly in order to have efficiency and flexibility.

In the UK, departments that are in the NHS are paid by the activity completed. This is called Payment by Results, and requires good data keeping and strict audit on all activity within the department, so that all income is accounted for.

Departmental budgets are usually broken down into the following components:

1. Pay – Staff costs
2. Non-Pay – All other costs
3. Income – Pay that is received by the department

In the UK it is common practice to cross charge for internal (within the hospital) and external (other hospital) work. This would account to the income the department will receive. Setting up local trading accounts can achieve this best.

1. Pay

The pay budget is allocated for staff. Once staff and their funding have been agreed, the institute accountant will assign an annual budget against each one. Pay budgets should be reviewed regularly especially when a vacancy occurs. This would allow a review of the service needs at the current time and provide an opportunity to prove the need for additional posts and/or restructure staff gradings to maximise numbers. Reviews of this kind are essential, as service needs do change and occasionally higher demand areas can be funded within the existing budget.

2. Non-pay

This budget represents all costs involved in running the Nuclear Medicine service. These are usually broken down into individual accounts such as equipment, radiopharmacy, maintenance, provisions etc. Again, the institute accountant will place a budget limit to each account based on an estimate of the true costs from previous years. Good management of this budget is required to prevent overspending. Items should be charged to the correct account so that a review at the end of the year shows a true reflection of where adjustments need to be made for the following year. Regular (monthly) review of each account is important, as during the financial year it may be found that certain accounts are not being used whilst others are at risk of being overspent. By making slight adjustments across accounts, it is possible to balance each account properly, making the end of year review easier. Occasionally, however, it may be found that a budget set against an account is not used at all until a particular month. An example of this would be a contract of some kind, for which a bulk payment is taken in one

month only. In these cases, accounting methods can adjust for this so as not to give a false impression of the account.

3. Income

Most departments will receive income, mainly for services to outside institutes usually via service level contracts or monthly activity recharges. These budgets are reviewed at the end of every financial year. Managing income is very important. All activity must be logged and cross-charged so that regular income payments are made. Late payments need to be borne in mind at monthly reviews. If excess income is obtained, this can be used for off-setting any other budgets such as pay or non-pay, but this is rare once annual budgets are set.

1.4. Risk Assessments and Incident Training/Practice

Anil Vara

Risk assessments

Risk assessments should be carried out before any new work within Nuclear Medicine commences. The most common types of risk assessments are based on radiation risks and health and safety issues.

These assessments are drafted, usually based on advice form the RPA (Radiation Protection Advisor), so relevant staff are aware of risks in each area of the department. They should be read by all personnel who would be working in the assessed areas. The assessments for associated radiation risk should be drafted for each area of Nuclear Medicine and regularly reviewed, preferably once a year or if an incident or "near miss" has taken place. During the review process, control measures must be updated to minimise the risk as much as possible.

The 5 steps to a risk assessment are as follows:

1. Identifying the hazard
2. Control measures in place
3. Evaluating the risks
4. Action plan/records
5. Review

Risk assessments should be kept as simple as possible and be concise. It is usually best to produce a series of assessments based on each room within Nuclear Medicine. An example is shown in Table 1:

Table 1: Risk assessments

Area	Types of risks associated
Gamma Camera room	Unsealed sources, patient contaminants, sealed sources, doses to staff from patients
Injection room	Dose rates to authorised staff, sealed and unsealed sources,
Waiting area	Dose rates from radioactive patients, patient contaminants

In the UK, all risk assessments must conform to IRR99 regulations (Ionising Radiation regulations 1999). Areas in Nuclear Medicine designated as controlled or supervised should be defined within the risk assessment.

Incident training

Unfortunately incidents do happen in Nuclear Medicine, even when assessments are made. When an incident does occur, it must always be documented, with records filed. A review must take place following the incident, so the risks associated can be minimised further, if possible.

The radiation protection supervisor should have a training programme, which all staff working in relevant areas of Nuclear Medicine should undergo, before commencing work. The training should consist of the following:

1. To read and follow the local rules for the department
2. To be familiar with the procedures when a radiation incident occurs
3. To be aware of the documents that need to be completed when a incident occurs
4. To be cognisant of the staff that have to be notified.

The local rules should be concise and as short as possible. They should contain key information such as contact details, types of sources within the department, decontamination procedures, and systems of work, operational procedures and contingency plans.

Generic hospital incident logbooks can be used for logging incidents. Although a purpose made record is just as good. Following an incident, a record should be drafted as soon as possible. Depending on the severity of the risk, incidents should be followed up quickly, reviewing systems of work to minimise the risk. All incidents should be discussed at the next radiation safety committee, where further support can be acquired, if needed.

Section 1 – Managing a Nuclear Medicine Service

1.5. Business and Strategic Planning

Anil Vara

Business planning in Nuclear Medicine is very important, especially when immediate or future changes need to be made. Nuclear Medicine is a growing area in medicine, and services have to be adapted in order to meet the rapid changes that will occur.

Initial planning

When an idea needs to be taken forward, such as new equipment, staff or even a new technique, it is important that all the evidence is available to take the plan forward and make its possible implementation as smooth as possible. The types of evidence that should be considered are:

1. Financial funding and support
2. Any income revenue or other benefits to the trust/organisation
3. Capacity and demand data for the Nuclear Medicine department
4. Recommendations and audits from recognised professional groups e.g. NICE (National Institute of Clinical Excellence, UK) EANM
5. Impact on the service if the plan is declined

Business case

The business case is the essential document, which will allow all the evidence to be placed together and illustrate options to be considered for the business proposal. The business case should be drafted accurately and in conjunction with the trust accountant. Once a business case is prepared, it is usually submitted to the trust board for approval and implementation.

Essentials of the business case

When drafting a business case, the following essential sections should be included:

1. Executive summary

This section should begin with an introduction and purpose of the case. Good evidence such as from regulatory bodies, government, commissioning bodies etc is well suited here. Following this, a section on demand and capacity of the current service should be included. This will be based on graphical representation of the demand (amount of work entering the service) and capacity (current staff and equipment) available and any changes proposed that may affect this. Finally, at the end of this section, a list of options should be listed. This is called an "options appraisal". Although, you will have evidence to support the new case, all options should still be considered in any business case. This should always include a 'Do Nothing' option, so the business case reflects all possibilities, including the impact on the service if the trust board rejected the business case.

2. Economic case

This section should be used for detailing and arguing the finance proposed for the case. It should begin by listing the finance requirements behind each of the above listed op-

tions. This is called an "economic appraisal". All finance initiatives, including negative impacts, should be included under each option.

Following this, an assessment of the risks and benefits of this case should be made. This is very similar to a risk assessment in Nuclear Medicine, where a scoring method can be derived and used to measure the positive and negative aspects of each option. All associated risks and benefits should be included to make the case look strong. The outcomes of the scoring can be presented in a results section, followed by a simple conclusion.

3. Finance and recommendations

This last section should indicate the amount, source and pressures of the financial support needed to justify the best option. Usually at this point, prior agreement of the source of funding will have been obtained and this will need to be documented here.

The final recommendation should highlight the best option to proceed with. The data provided in the relevant section should agree with the department's recommendations, and if the evidence is clear, usually the business case is accepted. Occasionally, one or more options may be suitable; and in these types of situations it is very difficult to agree on the case. But, when possible, if there is just one feasible option in the recommendations, it works to the department's advantage.

Section 1 – Managing a Nuclear Medicine Service

1.6. Audit/Clinical Governance

Anil Vara

Audits (examinations of records to check their accuracy) and clinical governance (the system through which organisations are accountable for continuously improving the quality of their services and safeguarding high standards of care, by creating an environment in which clinical excellence will flourish) are essential in Nuclear Medicine as with any other part of medicine. Clinical governance teams (or equivalent) should be set up to perform this. The audit group should comprise of essential staff from each clinical area. A person specifically employed within speciality areas, such as Radiology and Nuclear Medicine, would normally lead on this.

When audit projects are set up, they should begin with a definite aim and methodology. Audits within the service should cover the following areas:

1. Change or implementation of clinical practice
2. Changes in service provisions with best patient care practice
3. Evidence towards a new business case

The aim of the sub specialty group is to ensure that best practice is always implemented and any new evidence that arises can be discussed for feasibility to improve patient management. Generally once the group agrees to the results, these are used to implement any changes and support any further case. Discussions and ideas from these meetings should be taken forward to management meetings where final decisions are made. All audits should be well documented, even published, and available to any external auditors.

1.7. Accreditation 'Quality Awards'

Anil Vara

Accreditation towards a good Nuclear Medicine service is always an indicator of high achievement and movement in the right direction. Essentials of a good quality service should include

1. Good written policies and procedures for the department
2. Practice that complies well with the local regulations
3. A review structure that covers all aspects of Nuclear Medicine
4. A department that liaises with other institutes within a local area and gets involved with local activities to help maintain a good level of service.

Well written policies and procedures are essential. They help maintain professional and safe practice in Nuclear Medicine as well as help develop the service through audits and reviews.

Practice in conjunction with regulatory bodies is very important. For example, in the UK, the Department of Health has written various documents that require compliance. Although the practice associated with implementing these documents will vary from department to department, the principles remain the same. Good communication with other institutes will help achieve this as well as regular inspections by the governing bodies to highlight areas of poor quality. Professional institutes such as National and European Nuclear Medicine societies will draft polices and procedures which should be followed.

Reviewing current practice should give an opportunity to enhance the service or deal with a concerning situation. Reviews should be made in line with local or national audit programmes/data and should be included across the whole function of the department including staff competencies.

Taking the department's work forward to National or European meetings is an essential practice to demonstrate to other institutes how the department is progressing and to share new initiatives. Usually single or joint departmental ventures are undertaken. Most departments do find it difficult to take this forward, due to service and staff pressures, but this should be encouraged as far as possible. This is why joint ventures can make it easier.

Section 2 – Guidelines / Policies / Protocols

2.1. Available Guidelines

Brendan McCoubrey

In preparing a document on best practice in Nuclear Medicine, it is important to draw on the existing research, which has been conducted by the various relevant authorities concerned with the provision of a Radionuclide Imaging service throughout the world. In particular it is necessary to focus on the guidelines which have been formulated in the context of evolving European legislation and practice. National interpretation of European Regulations on the administration of radioactive substances and differences in clinical practice and service delivery mean that guidelines do not readily apply across regional and national boundaries. The European Association of Nuclear Medicine (EANM) http://www.eanm.org recognises the need for the development of clinical guidelines at an institutional level to incorporate those aspects of the available guidelines that impact on the tailored service provided by the institution.

Of greater relevance than detailed guidelines covering performance aspects of individual diagnostic and therapeutic procedures are Generic Quality Guidelines, which outline the performance characteristics affecting overall quality. From these Generic Quality Guidelines, individual institutions should derive specific local guidelines covering those practices relevant to their service requirements.

By following the links given, a cross section of the existing guidelines provided by relevant authorities at both European level and worldwide can be found. These guidelines are resultant from the research assimilated by the national and international institutions. A brief introduction is given concerning the history of the particular association.

Guidelines are available for download on the EANM website at the following address : http://www.eanm.org/scientific_info/guidelines/guidelines_intro.php?navId=54

International Links

Further links to the International Associations and Societies may be found at the following address: http://www.eanm.org/pat_info/links.php?navId=57

Nationally produced guidelines can be found on each society's website.

2.2. Protocols and Policies in Nuclear Medicine Departments

Helen Ryder

A cornerstone of good practice in a Nuclear Medicine department is the development and usage of protocols and policies for that particular unit. Of differing origins, protocols tend to be an amalgam of standard scanning techniques with local radiological preferences whereas policies are normally devolved from legislation regarding the use of diagnostic radiation or the health and welfare of the patient.

So – who uses these protocols?

The development of protocols is intended to standardize technical factors, timing of imaging and the views obtained during imaging to provide the best information from which the scan may be reported. By making these protocols available within the department, either electronically or on paper, new or rotating staff/personnel may be kept up to date on latest changes in techniques. It also acts as a reference for examinations that are not regularly performed by the department.

Reference to written protocols can also alert staff members to the individual needs of the reporting clinician. Most departments have more than one member of the medical staff who undertake and oversee scanning sessions, and adaptations by scanning staff to their preferred techniques are of vital importance.

Developing protocols

A starting point in preparing an examination protocol is to list the technical factors required to complete the scan. These factors can include:

- Equipment used – in a multi-camera department some equipment may be more suitable than others. Myocardial perfusion imaging generally requires the use of a multi-tangential dual-headed gamma camera; brain imaging may best be facilitated by utilising a dedicated triple-headed system.

- Quality Assurance and pre-set Gamma Maps – when using rotating cameras, or differing or multiple isotopes, preliminary QA and gamma maps may need to be performed or defined.

- Radioisotope – isotope channel, peak and acceptance window to be used.

- Acquisition Parameters :

Matrix size – can vary either for type of acquisition required (dynamic; planar; tomographic) or within a specific acquisition (e.g. The vascular/dynamic and blood pool/static planar phases of bone imaging). These are usually set within the acquisition protocol logged onto the scanning computer.

Type of acquisition – e.g. dynamic, static, whole-body, SPECT, gated.

Time of acquisition/count statistics – some images may be ended by reaching either a time or count limit, or in terms of gated studies by the number of cycles completed.

Indications/Contraindications – in some cases the scan requested may not be the most appropriate examination. The Royal College of Radiologists (UK) in London has produced a booklet which offers guidance in these cases for a wide range of diagnostic imaging procedures. The booklet is called 'Making the best use of a Department of Clinical Radiology' and is available through their website at http://www.rcr.ac.uk/index.asp. The European Commission has adapted the RCR referral guidelines for use in their guidance document Radiation Protection 118 "Referral guidelines for imaging", which is available at the following web address: http://ec.europa.eu/energy/nuclear/radioprotection/publication/doc/118_en.pdf.

Contraindications can apply both for choice of examinations or, more relevant in departmental protocols, for medical and physical reasons. For example when choosing a pharmaceutical for myocardial stress procedures, it should be noted that asthmatic patients should not be given either adenosine or dipyridamole. Physical limitations may also define which examination may be appropriate e.g. difficulty in performing physical exercise.

- Patient Preparation – of vital importance in the production of diagnostic scan results, these should be defined for all examinations performed in the department. Preparations should include the need for fasting; hydration requirements; medications to be halted prior to examination; medication to be taken pre- and/or post examination. The timings of such preparations as well as medication lists etc should be logged both in the protocols and any information sheets sent out to the patient when the appointment is scheduled.

- Scan time delays – some examinations require that scans be performed at certain time intervals, be they minutes, hours or days. These timings should be included in the protocol listings.

- Images/views taken – whilst many examinations can be performed as pre-programmed imaging e.g. wholebody procedures, others require a series of static planar images to be taken to demonstrate the physiology required. This includes, for instance, the multi-planar imaging of lung perfusion using Tc^{99m}-MAA. A typical series of the lungs may include: Anterior; Posterior; Left Anterior Oblique; Right Anterior Oblique; Right Lateral; Left Lateral. Positional angulations should be recorded for successful comparative imagery.

- Adaptation of protocols – although the framework of a successful scan is laid down in the protocol list as above, it should be

noted that this protocol can be adapted for the medical condition of the individual patient or for the requirement of a particular requesting physician. An example of this adaptation could be the basic Isotope Bone Scan. Different patient history could influence the views taken during the examination in the following ways:

- metastatic disease --- wholebody scan plus detailed static planar imaging of areas of interest.

- osteo- or rheumatoid arthritis --- wholebody scan plus static planar imaging of hands and feet

- infection/fracture e.g. diabetic foot --- dynamic imaging of area of interest with three-hour delayed static planar imaging of relevant areas

- mandibular asymmetry --- static planar imaging of head plus SPECT imaging of mandible.

- Analysis protocols – many nuclear medicine examinations require that data be analyzed and presented in certain formats, especially where final figures are produced e.g. ejection fraction as a result of gated cardiac wall motion studies (MUGA scans). In most cases the analysis is objective, utilizing preset analysis programmes, but some variations can be introduced in their usage with reference to positioning of regions of interest. To minimize the subjective effects of individual on the various programs, protocols should be included to give step-by-step guidance in their accurate application.

- Relevant papers – copies of relevant articles, papers, monographs and manufacturers details are often useful to include within a protocol file, for additional reference and constant updating of good practice.

A sample protocol is shown in Appendix 1.

Appendix 1: Sample protocol (Courtesy of St. James's Hospital, Dublin)

Gallium^{67} Whole Body Scans

Radiopharmaceutical:	110MBq Gallium-^{67} Citrate (one patient dose). Radiologist should give injection.
Patient Preparation:	Day 1 – Ga^{67} injection given – no scans. Day 2 – no scans. Patient should fast from midnight, be given bowel preparation for next day. Day 3 (48 hours) – Scan, patient to fast and be given further bowel prep Day 4 (72 hours) – Scan
Scan Delay:	Scan on Day 3 (48 hours) and Day 4 (72 hours)
Scan Name:	Ga^{67} wholebody scan (48hrs), Ga^{67} wholebody scan (72 hrs), Ga^{67} planars (under 'Other' on protocols list)

Scan Parameters:

Camera:	Axis Dual-head
Isotope channel:	Ga^{67} , 184, 296, and 388 keV, 10- 20% window widths
Collimators:	MEGAP
Routine Views:	Wholebody scan (anterior and posterior) + planars of areas of interest if necessary at 48 Hours and 72 hours post-injection. Due to low injected and retained activity, tomography is not routine.
Indications for Scanning:	Non-specific infection, inflammation, PUO; tumors; sarcoidosis
Display:	As wholebody display, attach relevant static images. Label with scan type and time (post injection) for each day.

Application of Departmental Policies

Policies are designed to be applied within the Nuclear Medicine department as a whole, rather than on an individual scan basis. The policies generally are developed from the point of view of good practice, including radiation protection, health and safety, and infection control. All policies should be applied with the full knowledge and co-operation of all branches of personnel within the department (nuclear medicine physician/radiologist, physicists and radiographers/technologists) and should be made known to all clinicians and departments making use of the range of services offered by the Nuclear Medicine department.

Radiation Protection –

- Radiation dose to the patients – as most nuclear medicine procedures require an injection of radioactive material attached to a tracer, utmost care must be taken to ensure that the correct procedure has been selected to maximize diagnostic suitability; that the radioactivity of the injected dose follows the principles of ALARA (as low as reasonably achievable) or ALARP (as low as reasonably practicable); that the patient has been given adequate information prior to the procedure and such aftercare details as are appropriate.

- Protection with regard to a possible pregnancy – the prime responsibility for identifying such patients lies with the referring clinician, but all personnel involved are expected to actively ensure that radiation is not used inappropriately with regard to possible foetal irradiation.

All nuclear medicine procedures require that precautions be taken when administering radioactive materials to females of child-bearing age. Details can be set locally but with regard to nuclear medicine procedures the '10-day Rule' is most often applied. This requires that all examinations that include exposure of the pelvic regions be deferred until the female is within the first 10 days of the menstrual cycle. Generally the only nuclear medicine procedure that can be carried out during pregnancy is an isotope lung perfusion study, and in many cases CT Pulmonary Angiograms are performed instead. The European Commission provides practical advice on the protection of pregnant patients and breastfeeding mothers in the guidance document Radiation Protection 100 "Guidance for the protection of unborn children and infants irradiated due parental medical exposures", which available at the following web address:

http://ec.europa.eu/energy/nuclear/radioprotection/publication/doc/100_en.pdf

- Radiation protection of staff – where a patient is due to undergo a series of examinations on the same day, either in the x-ray department or in other diagnostic procedural units, these examinations should preferably be performed prior to the nuclear medicine examination. Where this is not possible e.g. during breast surgery following sentinel node imaging, protocols for such procedures should have been confirmed in advance and put in operation with the theater and pathology staff concerned.

  For inpatients undergoing a nuclear medicine examination – following the injection of radioactive material or when a nuclear medicine procedure has been completed, an advice sheet is sent with the patient to the ward regarding the type of procedure undertaken, the radiopharmaceutical and dose administered and the time for which any restrictions apply.

  Sample advice sheets are shown in Appendix 2.

Appendix 2: Sample advice sheets (Courtesy of St. James's Hospital, Dublin)

DEPARTMENT OF NUCLEAR MEDICINE

ST.JAMES'S HOSPITAL

Name of Patient: _____

Consultant: _____ Ward: _____

Date: _____ Time: _____

The above named patient has attended the Nuclear Medicine Department for the following:

Scan Type: _____ Isotope: _____

Activity: _____

The following precautions should be followed for a period of 24/48/72 hours (delete as necessary).

1. In general, try to avoid unnecessary close contact (less than 0.5m) with the patient.
2. Examination gloves and plastic aprons should be worn when handling urine bags, bottles, bedpans and dirty linen. Any spillages should be cleaned up quickly and carefully.
3. Soiled linen should be bagged and then stored for 24 hours before being sent to the laundry.
4. Pregnant staff should minimise the time spent close to the patient and avoid close contact where possible.
5. Pregnant visitors or small children should not be allowed to visit the patient for the period of these restrictions.
6. Consider postponement of non-urgent investigations and treatments requiring staff working in direct contact with the patient for more than 5 minutes.
7. Patient should drink plenty of fluids and empty bladder frequently.

SPECIAL PRECAUTIONS:
For further information, please contact the Nuclear Medicine Department.

Guidance Notes for Nursing Staff Caring for Nuclear Medicine Patients

Background

Patients attending for nuclear medicine scans receive a pharmaceutical (usually although not always by injection) that has been labelled with a radioactive material. The pharmaceutical is selected so that it is processed or metabolised in the organ of the patient's body that the clinician wishes to assess. After the patient has been injected he/she is effectively radioactive and can act as a source of exposure to those with whom they come into contact. Although this exposure will be relatively low, in order to minimise staff exposure, some simple precautions are advised and these are outlined below.

The isotope that is used most frequently is Technetium-99m (Tc-99m). This is a relatively short-lived isotope with a half-life of approx. 6 hours. In effect, this means that precautions generally only have to be followed for a period of 24 hours after the isotope scan. Occasionally, other isotopes (e.g. Indium-111, Gallium-67, Thalium-201, Iodine-123, Iodine-131) are used. Because some of these isotopes have longer half-lives than Tc-99m, precautions have to be followed for a longer period. The time for which precautions should be followed will be indicated on the information sheet that is sent back with the patient from the Nuclear Medicine Department

Guidance

The following guidelines should be followed for the period indicated on the instruction sheet accompanying the patient back from the Nuclear Medicine Department:

1. In general, try to avoid unnecessary close contact (less than 0.5m) with the patient.
2. Examination gloves and plastic aprons should be worn when handling urine bags, bottles, bedpans and dirty linen. Any spillages should be cleaned up quickly and carefully.
3. Soiled linen should be bagged and then stored for 24 hours before being sent to the laundry.
4. Pregnant staff should minimise the time spent close to the patient and avoid close contact where possible.
5. Pregnant visitors or small children should not be allowed to visit the patient for the period of these restrictions.
6. Consider postponement of non-urgent investigations and treatments requiring staff working in direct contact with the patient for more than 5 minutes.
7. Patient should drink plenty of fluids and empty bladder frequently.

For further advice or information, please contact the Nuclear Medicine Department.

Health and Safety -

The health and safety of both staff and patients must always be placed first in any consideration of policies. Regrettably incidents can occur within a department ranging from a change or deterioration of the patient's condition that requires advisement of nursing or medial support to accidental injury to reactions to injected radiopharmaceuticals. Although the latter are relatively rare, they are not unknown, and a policy and protocol should be in place to ensure a record is made of such incidents, and to register them with the appropriate departments within the hospital or with manufacturers. Most hospitals have Risk Assessment teams that will log all incidences and place them on permanent file.

Infection Control -

Protocols regarding the operation of infection control procedures should be included in departmental protocols. With the rise of hospital-based infections such as MRSA and C.Dif., there is an increased need to be vigilant in the prevention of cross-infection. Rigorous cleansing regimes should be enforced when known carriers of infections are scanned in the Nuclear Medicine department, and protective clothing and equipment utilized. Similarly, other pro-active steps e.g. usage of plastic protective sheeting on gamma cameras and scanning tables should be used when an infectious state cannot be ruled out.

The Nuclear Medicine department is also an area of high risk when it comes to blood-borne viruses, most especially HIV, because of blood-labelling techniques utilized for certain examinations. Sadly, instances where HIV infected blood products were inadvertently injected into the wrong patient have been recorded, resulting in infection of the previously-HIV negative patient. A report can found at: http://www.cdc.gov/mmwr/preview/mmwrhtml/00017383.htm

A proactive policy regarding the safe labelling and introduction of labelled blood products should be at the forefront of departmental infection control procedures.

Similarly, a policy and protocol should be in place to assist and record incidents involving contamination of staff through needlestick injuries. This should be co-ordinated with the hospital's Occupational Health Department.

Section 2 – Guidelines / Policies / Protocols

2.3. Clinical Research Policies

Linda Tutty

Knowledge and compliance with the Good Clinical Practice (GCP) is essential for everyone involved in clinical research trials. Clinical trials should be carried out within the framework of a good clinical practice environment in accordance with international guidelines and regulations as detailed in the Declaration of Helsinki. Research trials involving ionising radiation require adherence to the ALARA (as low as reasonably achievable) principle. The International Commission of Radiological Protection and the World Health Organisation (WHO) have publications that deal with this issue in clinical research. From the legislation point of view, the 97/43/EURATOM Directive represents the most comprehensive reference to clinical research using ionising radiation. While GCP should form the backbone to successful nuclear medicine clinical studies, radiopharmaceuticals used in these trials need to be produced according to the Good Manufacturing Practice (GMP). Compliance and understanding of the GCP is essential to everyone involved in clinical research.

In an effort to overcome international GCP inconsistencies throughout countries, the International Conference on Harmonisation (ICH) published the ICH Guidelines: A number of components have been included to ensure the protection of trial subjects and the quality/integrity of data obtained from clinical testing.

These are:

- Institution review board (IRB)/independent ethics committee (IEC) review and approve;
- The trial protocol;
- Freely obtained informed consent from each subject;
- Safety monitoring requirements;
- Data handling and archiving requirements;
- Clinical trial responsibilities of the IRB/IEC, investigator and sponsor.

The IRB/IEC protects the rights, safety and well-being of all trial subjects. The IRB/IEC should examine the qualifications of the investigator for the proposed trial. It should carry out reviews of each ongoing trial at intervals appropriate to the degree of risk to human subjects. The IRB/IEC may request for additional information be given to the subjects where that information would add to the rights, safety and/or well-being of the subjects. The IRB/IEC should establish that the proposed protocol and other documentation adequately address relevant ethical concerns and meet applicable regulatory requirements for trials.

Accurate dosimetry

Clinical trials involving the use of ionising radiation, as in the case of nuclear medicine, require special consideration with regard to the GCP. In addition to direct detrimental effects, protection of humans against ionising radiation requires consideration of the probability of induction of stochastic effects, such as cancer and induction of leukaemia, even at low doses. The benefit to society, by increase in knowledge, must outweigh the potential harm to the exposed individual. Such research trials should only be performed on a voluntary basis as set out in the Declaration of Helsinki.

Different organisations have published specific recommendations with respect to research using ionising radiation in medicine. The WHO published a report in 1977 concerning the use of ionising radiation and radionuclides on human subjects for areas including medical research. More recently the International Commission on Radiological Protection (ICRP) published a number of documents on the protection of patients with recommendations in nuclear medicine, including exposure in biomedical research (Bacher & Thierens, 2005).

From the legislation perspective, in the EU, the 97/43/EURATOM Directive represents the reference to clinical research using ionising radiation (Bourguignon MH, 2000). In this document the justification and optimisation of exposure following the ALARA principle is crucial. With respect to optimisation, it is important for accurate calculation of patient radiation doses, and in the case of diagnostic cases, to ensure that the radiation dose is as low as possible. For therapeutic purposes, such as radionuclide therapy, there is a requirement for individual treatment planning by monitoring the absorbed dose of the target volume and by considering possible detriment of non-target tissues. The effective dose may be used as an overall indicator of the risk on late stochastic effects to an average individual. Mean organ doses and effective doses are typically derived based on the data available in ICRP publications 53, 62 and 80. If no established biokinetic models exist for the applied radiolabelled tracer, dosimetry may be based on animal experiments which should be then tested in pilot research on human subjects before any extensive research is planned. For radionuclide therapy investigations, where deterministic effects may occur, doses to critical organs outside the target volume should be examined accurately and individually for each patient.

Good Manufacturing Guidelines

With the introduction of the European Directive, all pharmaceuticals used in clinical studies must be prepared under good manufacturing practice (GMP) conditions (De Vos et al, 2005). Radiopharmaceuticals for clinical research purposes must be manufactured in accordance with the basic principles of GMP. Due to their short half-lives, many radiopharmaceuticals are administered to patients shortly after their

production, so some elements of the quality control may be retrospective. Therefore strict adherence to GMP is essential. Special attention should be given to the production area environment and personnel, the two basic requirements of GMP production.

Radiopharmaceuticals are nearly always used before all quality control testing has been completed. Therefore the compliance with the quality assurance programme is crucial. Quality assurance should incorporate the monitoring and validation of the production process.

When conducting research trials in nuclear medicine, special attention should be given to the guidelines and legislation surrounding GCP, radiation dosimetry and GMP. GCP and the policies linked to it should be well understood before contemplating any clinical research study in nuclear medicine.

Section 3 – Staff Aspects of Best Practice

3.1. Best Practice for Recruitment and Selection

Wendy Gibbs and Julie Martin

This Recruitment Chapter has been designed to enable you to help carry out the recruitment and selection process effectively.

The following objectives should be achieved:

- The right candidate should be recruited, ensuring equality of opportunity for all candidates and that there is the right candidate for the right job in the right place.
- The recruitment process should take place in a timely and cost effective way.
- Relevant legislation should be taken into consideration.

The three stages in the recruitment process are:

- Defining Requirements
- Attracting Candidates
- Selecting Candidates

Defining the requirements when the vacancy occurs, the first questions to ask will be:

- Is there a vacancy?
- If there is, who do we need to fill the post?

Sometimes it may be a case of reorganising the work or using agency staff or making the job part-time or a job-share. We should always analyse the requirements at that moment in time as well as consider future plans and requirements.

In order to define the requirements the following steps must be undertaken:

- Job Analysis
- Job Description
- Personal Specification

Job Analysis

It is necessary to ask what the job consists of and whether it is likely to be any different than that of the previous postholder. Nuclear Medicine covers many areas and the skills required of a Nuclear Medicine Technologist post will vary. It may be that a specialist such as a Nuclear Cardiology Technologist is essential or a technologist who is newly qualified, to ensure that the right 'mix' of staff is there supporting the clinical work and providing career progression.

Job Description (See Appendix 1)

The following should be included:

- The context of the post including responsibilities and accountabilities
- A small paragraph on the job summary

- The job content will include the main duties and responsibilities to encompass managerial, clinical, professional & teaching responsibilities and research & development duties if appropriate

Personal Specification (See Appendix 2)
The personal specification should provide the following information:

- Essential and desirable qualifications
- Knowledge and experience required to undertake the job

Other information may be provided at this point, such as working conditions, potential career progression and in some cases performance standards.

Advertising
The most cost effective and appropriate method of recruitment should be selected. It is essential the advertisement is placed where candidates who are qualified to take on the role are most likely to look. In some cases this may mean advertising internally only or internally and externally simultaneously. This will depend on the market forces and candidates available locally.

The following is a checklist of items which should be included in the advert:

- Name & Brief details of employing organization
- Job role and duties
- Training to be provided
- Key points of the personal specification
- Salary
- Instructions on how to apply

At this point the interview date may be set.

Shortlisting
Using the essential criteria in the personal specification, panel members individually produce a list of applicants that meet the criteria. They will be scored according to criteria provided. The panel will then reveal their lists and find a consensus. Successful candidates will then be invited for interview.

Interviews for Nuclear Medicine Technologists will not generally involve a test, however it is suggested that in a senior role, a presentation may be appropriate. Some organizations may use psychometric testing as a matter of course.

Interviews: Points to remember
- Legible notes to be written by each panel member during the interview.
- The same questions should be asked apart from specifics related to the CV and

particular issues that may arise out of the application form and/or the interview.

- Attention to any legislation such as the (UK) Disability Discrimination Act should be practiced.

- Preparation is essential both by individuals and the panel. It is necessary to decide who is chairing the interviews. In most cases this will be the most senior person. For a Technologist's post it would be appropriate to have the Senior or Chief Technologist, Physicist or Radiopharmacist and/or a Medical Physician depending on the seniority of the post.

- The interview should start with introductions and outline the interview process. General biographical information would be examined first followed by examination of the application form and competencies identified for the job. The panel will be listening and answering questions and the chairperson closes the interview by summarising and confirming future actions. He/she may be responsible for checking qualifications and details related to occupational health and accommodation.

- All panel members should be given a copy of the interview plan before the interview.

- Attention should be paid to the environment e.g. mobile phones switched off.

- Ensure preparation is timely.

- Don't leave candidate waiting and explain any unforeseen delays.

- Ensure professional conduct at times throughout the process.

Upon completion of the interview, individual members of the panel give their feedback and agree on the appointment (or not) by consensus.

Subject to the organisation's policy, offers may be made subject to; references, occupational health clearance and/or Criminal Record check.

A job offer will be sent out formally and commencement procedure and start date discussed.

APPENDIX 1

Sample Job Description

Post Title:	Senior Nuclear Medicine Technologist
Service:	Nuclear Medicine
Hours of Work	37.5 hours
Reports to:	Chief Technologist

Hospital / Organization Information

(small paragraph: 2-3 lines)

Nuclear Medicine Services

(small description 3-4 lines)
The Nuclear Medicine Department employs … staff and has an annual budget of …. The department undertakes general nuclear medicine and osteoporosis screening. The department has its own radiopharmacy and works within the radiology unit.

Job summary

To provide high quality diagnostic images across the range of all Nuclear Medicine investigations. An understanding of the departmental protocols is essential. Encouraging the highest professional and technical standards in all staff by personal example and constructive supervision.

Main duties / key responsibilities

1. Perform all clinical nuclear medicine procedures using specialized equipment, in a timely and accurate manner.

2. Perform all diagnostic & therapeutic procedures with due regard for Health & Safety of self, patients and staff.

3. Undertake administration of all diagnostic radiopharmaceuticals and drugs used in the practice of nuclear medicine.

4. Assist in cardiac exercise and pharmacological stress testing.

5. Schedule all nuclear medicine studies in accordance with departmental protocol.

6. Take responsibility for patient consent, identification and relevant clinical details.

7. Provide clinical information to the patient whilst interpreting, negotiating and adapting the procedure as applicable to that patient.

8. During exposure to sealed and unsealed radioactive material, blood samples and other hazardous waste, ensure working practice is in accordance with government legislation and departmental policies.

9. Understand and apply all relevant legislation when performing all nuclear medicine investigations.

10. Undertake quality assurance of all relevant equipment and take responsibility for reporting discrepancies to appropriate personnel.

11. Participate in research and development studies being carried out in the department.

12. Take responsibility for continuing professional development while liaising with the line manager for advice, guidance and allocation of appropriate resources for training and development.

Standard Requirements

The post holder may be required to carry out other duties in line with the grading of the post.The job description may be subject to change and if so this will take place in consultation with the post holder.

The following policies should be adhered to at all times as per induction: Confidentiality, Code of Conduct, Equal Opportunities, Health and Safety, Smoking Policy, Data Protection Act, Terms and Conditions of Employment.

APPENDIX 2

Sample Person Specification

Person Specification
Senior Nuclear Medicine Technologist

Qualifications

Essential: BSC Radiography or other relevant science degree with a post graduate qualification in nuclear medicine or Nuclear Medicine Degree (BSc Applied Science in Nuclear Medicine Imaging)

Desirable: Paediatric IV cannulation course
ILS or ALS certificate
Basic and advanced ECG interpretation
EANM PET course or equivalent
CT accreditation

Knowledge & Experience

Scientific, Technical & Clinical

- Minimum 5 year full-time experience post qualification.
- Competent in all nuclear medicine procedures.
- Demonstrate an ability to work within a multi-disciplinary team.
- Competent in all data acquisition and analysis for nuclear medicine procedures.
- Able to recognise normal and abnormal bio distribution of radiopharmaceuticals.
- Provide a high quality professional standard of care to both patients and staff.

Legislation: Understand and comply with relevant legislation, national standards, and professional guidelines.

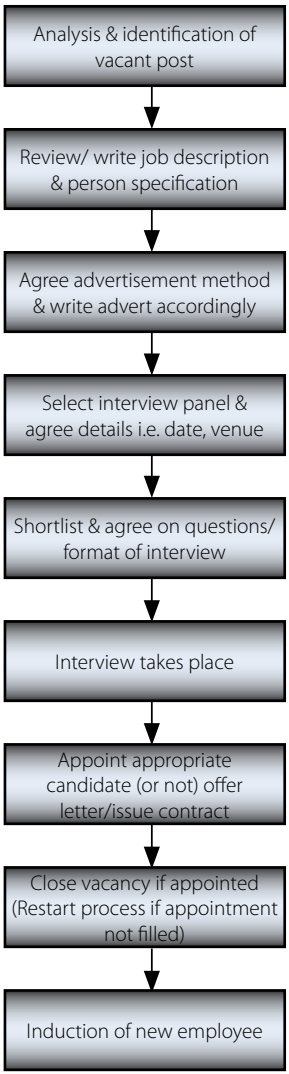
Skills:

IT: Proven IT skills to intermediate level on MS Office & Outlook.

Communication: Developed skills required to work with patients and staff from diverse backgrounds. Capable of extracting/imparting sensitive information.

APPENDIX 3

Recruitment Flow Chart



Usually the following tasks fall to the HR/Personnel Department within an organisation: placement of advert, sending out recruitment packs, preparation of short-listing packs, notification and invitation to candidates, regret and offer letters, securing references, issuing contracts.

3.2. Best Practice for Induction

Wendy Gibbs and Julie Martin

Providing an effective and thorough induction ensures new starters are settled quickly into their new working environment. It is about presenting the basics that experienced employees take for granted.

A good integration into the working environment must include the following elements:

- **General training** relating to the organization, including values and philosophy as well as structure and history, organizational charts etc. (see appendix 1)
- **Mandatory training** relating to health and safety and other essential or legal areas.
- **Job training** relating to the role the new starter will be performing.
- **Training evaluation**, entailing confirmation of understanding, and feedback about the quality of and response to the training.

It is the responsibility of a new employee's manager to ensure that induction training is properly planned. An induction plan should be issued to the new employee on their first working day if not before and sent to all staff involved with the training. Although an induction period should be specified, there is no right 'induction time' for new employees. In some instances an induction can span over a few months. In these cases it is important for the new employee that the induction does not lose momentum and that s/he has 'protected time' to undertake and complete the induction period.

Induction is a two-way process. The manager is responsible for ensuring:

- That the information, explanation, guidance and direction needed is provided within the induction plan.
- That mandatory training required has been booked e.g. Basic life support, fire training etc.
- That the new employee has the opportunity to ask questions and seek guidance.
- That the new employee is effectively inducted into their job and competent to undertake the necessary tasks safely.
- That a checklist for induction is provided to ensure all areas are completed (see appendix 2) and sign off as completed (see appendix 3).

The new recruit is responsible for:

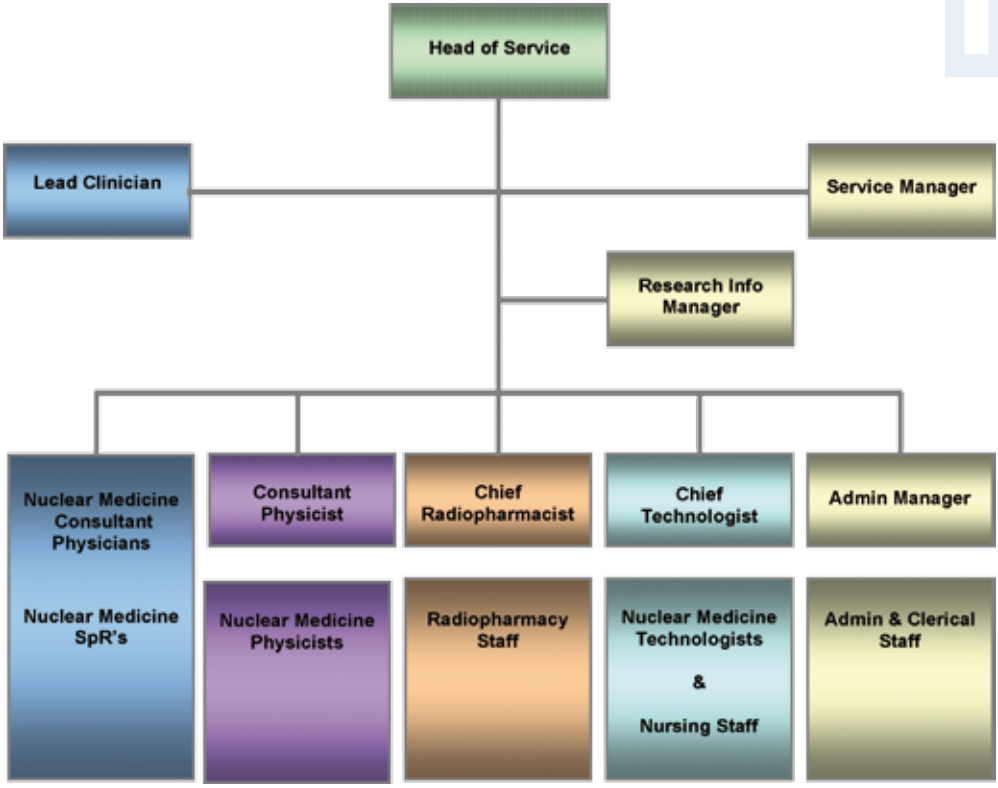
- Reading and absorbing all information provided throughout the induction period.
- Attending any training provided and required as part of the job.

- Asking questions and seeking guidance where help or clarity is needed.
- Completing and making the most out of the planned induction.

The following checklists have been provided as a guide (and are by no means all encompassing) to help facilitate the induction process.

APPENDIX 1

Organisational Chart



APPENDIX 2

Induction Checklist

Employee Name: _____

To be achieved within the first week of starting	Tick as appropriate	
	Done	N/A
I have been introduced to my Personnel Team		
I have signed my joining papers (for payroll)		
I have been given the opportunity to have an induction buddy		
I have discussed the job description and person specification and understand the purpose of my job		
I have been formally introduced to:		
Other members of my team/dept		
Head of Nuclear Medicine Service Manager		
Lead Clinician for Nuclear Medicine		
Other Consultant Colleagues within dept		
Key Clinical Staff (list staff)		
Key Consultant Colleagues outside of dept		
Key Management Staff (list staff)		
Divisional Management Team		
I have been shown:		
The layout of the department		
Any areas I will be working in outside my department/ward		

Fire escapes, the location of fire alarm points and the fire assembly point		
Toilets/cloakroom/rest room facilities		
Area to store and make refreshments		
Staff dining facilities		
Telephone facilities		
Bleep system		
The location of the first aid box		
The location of the resuscitation equipment		
The photocopying facilities		
The location of linen room		
The equipment I will be using - computer, medical equipment etc.		
The location of the post room		
The location of the security office		
I have been advised of:		
The cardiac arrest number		
The fire & emergency security number		
I have been provided with:		
Uniforms		
Facilities to lock away my personal belongings		
A current copy of the organisation's Newsletter/Team Briefing Reports		
A copy of the Staff Handbook and staff policies summary		

A copy of the Organisation's Code of Conduct		
An ID Security Badge/Access Swipe Card		
Training: I have been given a date to attend:		
Fire training		
Training in basic life support resuscitation		
Training in paediatric life support resuscitation		
Manual handling training		
The corporate induction programme		
Child protection training		
Training to receive organisations IT system/s		
Profession-specific induction (if provided)		
Local induction programme (if provided)		
I have been made aware of the following policies/procedures:		
Hours of work, rotas, breaks		
Salary payment procedures		
Sickness reporting procedures, sick pay entitlement and medical certificate requirements		
Annual leave entitlement and booking procedure		
Policies and procedures manuals		
Fire alarm and fire drill procedure		
Data Protection Act and the importance of data quality		
Resuscitation guidelines		

Risk management guidelines		
Health risks and safety procedures including protective clothing		
Personal/patient security		
Medicines policy		
New patient records policy		
Raising a matter of concern policy		
Adverse incident reporting		
Compliments & complaints policy		
Waste disposal procedure/policy including types of bags		
Patient care philosophy		
Infection control & hand washing		
Standard Operating Procedures/ Service Level Agreements (SOPs/ SLAs as required)		
Confidentiality		
Regulatory policies affecting working area		
Any other procedures relevant to the area of work (please list):		
To be achieved within two weeks of starting		
I have been made aware of the following policies/procedures/ protocols:		
Access to medical records		
Equal opportunities policy		
Waste disposal policy		
Trust email and internet policy		

Staff benefits/facilities e.g. crèche, staff clubs, fitness centres		
Media policy		
Learning & development framework		
Major incident plan		
To be achieved within first month of starting		
I have been made aware of the following:		
My organizations & team objectives		
The Trust's Performance Management Process		
To be achieved within 3 months of starting		
I have a date when I will meet with my line manager to plan my performance and development objectives		
I have received a contract of employment		

APPENDIX 3

Sign off sheet

INDUCTION REVIEW FORM

Evidence of Induction Process

Name: _____ Post: _____

Start Date: _____ Department: _____

Induction completed: _____

Employee's comments:

_____

_____

_____

Manager's comments:

_____

_____

_____

Signature of Line Manager: _____

Date: _____

Form to be retained in Personnel File

3.3. Best Practice for Appraisal

Wendy Gibbs and Julie Martin

Good performance management means that people know:

- what they are being asked to achieve
- what they need to do to improve performance
- what they need to do to develop themselves

An effective way of achieving this is to ensure that, at least once a year, each member of staff has the opportunity to discuss with their manager/head of department matters relating to the area they work in or their professional and career development.

This can be supplemented by:

- shorter meetings during the year to feedback on progress to date
- team meetings/briefings
- mentoring
- regular, less formal feedback

Planning performance (Phase I)

During this phase, managers agree on the priorities for the coming year with their staff, and define the expectations they have for the individual's performance during the year, in line with the organisation's and the team's objectives.

Managing performance (Phase II)

During this phase, managers monitor progress, provide coaching and feedback to enable individuals to deliver to the best of their ability and to improve their performance. In addition, they discuss career aspirations and agree on individual development plans.

Reviewing performance (Phase III)

During this phase, managers review with individuals, performance against expectations in terms of standards, objectives, skills and competencies.

Structure of the performance planning meeting

1. Reviewing the role profile (job description & person specification)

You will need to review and update the role profile with the individual to ensure they have a clear understanding of the ongoing expectations of their role. Your discussion needs to cover:

- The role purpose.
- Key accountabilities.
- Standards of performance.
- Skills (e.g. IV skills are required for this post), knowledge (e.g. Technologist will be asked to demonstrate knowledge of IV policy), competencies (e.g. to ensure the compe-

tency is achieved, the Chief Technologist will observe 10 IV administrations).

2. Confirming the organisation's plans and priorities e.g. increasing skill mix capabilities of all clinical staff.

3. Setting performance standards/objectives e.g. within 6 months the individual will be able to inject all adult diagnostic radiopharmaceutical administrations.

Performance objectives should be focused on a limited number (probably 4-6) of performance areas which represent the key priorities for the individual in the coming year.

Prepare your Staff

- Arrange meeting with the individual (give at least 2/3 weeks notice).
- Give out performance management paperwork.

Prepare Yourself and the Environment

- Divert phone.
- No interruptions.
- Turn off bleep/mobile.
- Agree the length of the time planned.
- Book a quiet room.
- Look at the organisation's /team's plans and priorities and consider relevance to individual's role.
- Review the individual's role description/person specification and check it is still current.
- Review the standards that apply in the individual's role. Are they adequately covered in the role description? Update if necessary.
- Consider the contribution the individual could make to the team as part of their job. Consider potential performance standards/objectives.
- Identify the skills and competencies needed to perform in the job and any gaps. Consider potential development objectives.
- Map out a plan for the meeting.

Section 3 – Staff Aspects of Best Practice

3.4. Education and Training

Suzanne Dennan

Education and training ensures that Nuclear Medicine Technologists acquire the necessary knowledge and skills required to become competent health care professionals. The tasks undertaken by Nuclear Medicine Technologists greatly vary from one European country to another. Not surprisingly, education schemes for Nuclear Medicine Technologists also vary considerably between the European countries.

There are two basic models of education:

1. University-based training:
   - BSc degree after 3 – 4 years
   - MSc degree after 2 years
2. Professional school training:
   - 2 – 3 years duration
   - graduates are not awarded a university degree.

Within Europe, there is a lack of harmonisation of course curricula. For example, course content, hours devoted to theory and practice, and the delivery of practical training greatly vary. In some countries, unified radiology, radiotherapy and nuclear medicine training is provided, in others, nuclear medicine is offered as a separate course. In the university-based model, training is offered either at undergraduate or postgraduate level.

Consequently, the qualifications of Nuclear Medicine Technologists are not internationally comparable. Many European countries are experiencing a shortage of Technologists but are unable to employ other European Technologists because their qualifications are not recognised. At present, the education of Technologists in Europe should be in accordance with European Directive 89/48/CEE, which creates and monitors the conditions of exchange for professionals who *"have received education of at least 3 years' duration, on a superior level".*

Technologists with a 2 year qualification do not fit this criterion. Many countries using the professional school model are now moving towards university-based training in an attempt to unify the education system of Europe [1].

The EANM Technologist's Committee recognised that defining the competencies of a Nuclear Medicine Technologist was an important step towards a common appreciation of the role of the Technologist. In 1996, the Technologist's Committee presented a list of competencies for the European Nuclear Medicine Technologist. The EANM Entry Level Competencies document is available in the Technologist's section on the EANM web site (www.eanm.org). As the duties and responsibilities of Technologists vary nationally and at a local hospital level, the EANM Competencies are intended to indicate the highest possible standard of competence. It was envisaged that the Competencies would be helpful for setting up training programmes around Europe [2].

The EANM Competencies are divided into the following categories:

- Patient care and welfare
- Departmental organisation
- Instrumentation with quality control
- Performance of imaging
- Performance of in-vitro tests
- Radiotherapeutic procedures
- Radiopharmacy
- Radiation protection
- Occupational health and safety

The following syllabus of education is recommended by the EANM Competencies:

- Physics and instrumentation of nuclear medicine
- Clinical application of radionuclide imaging
- Radiation protection and quality control
- Anatomy, physiology and pathology
- Radiopharmacy including labelling and quality control of radiopharmaceuticals
- Computer technology and image analysis
- Research methods
- Management of a quality service
- Case studies

Practical training in a Nuclear Medicine Department is an essential component of a Nuclear Medicine Technologist's education. Without adequate practical training and supervision, student Technologists will not develop the necessary skills required to become fully competent. In many departments, students and new staff are given practical training by the working Technologists. Usually, Technologists have not received a formal education in teaching methodologies and have limited opportunities available to obtain extra training in teaching.

In 2005, the EANM Technologist's Committee made a short film called, *"Everything you wanted to know about teaching but were afraid to ask"*.

The aim of this film is to give Nuclear Medicine Technologists an insight into how to teach students effectively. The EANM teaching film is also available as download in the Technologist's Section of the EANM web site (www.eanm.org).

The EANM Technologist Committee plays an

important role in the education of Technologists in Europe by:

1. Establishing and supporting mechanisms within the EANM to develop the basic training, education and continuing education of Technologists, e.g., the establishment of a PET/CT course at the EANM educational facility.

2. Setting advisory standards for education and training, e.g., the competencies.

3. Supporting and endorsing other organisations providing education and training.

The education and training of Technologists is essential for the professional development of the Nuclear Medicine Technologist. It is important to remember that the student Technologists of today are part of our legacy and reflect on us as well as on future Technologists.

Section 3 – Staff Aspects of Best Practice

3.5. Lifelong Learning and CPD

Suzanne Dennan

The process of learning is often considered to be solely associated with school or university, but at any stage of life, the ability to learn is fundamental to the future development of the Nuclear Medicine Technologist.

All Technologists need to adapt to the rapidly changing environment within which they work. The advancement of Nuclear Medicine and PET technology, new practices, legislative changes and increased accountability necessitates continuous learning among Technologists. It is incumbent on Nuclear Medicine Technologists to make every effort to keep professional knowledge up to date, in order to maintain professional competence [1]. In some EU countries it will be a necessary part of maintaining a state registration, obligatory to work.

It follows that there must be some form of structured activity towards continuous learning known as continuous professional development (CPD).

CPD is defined as, *"the systematic maintenance, improvement and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life."[2]*

CPD is the means by which Technologists maintain, improve and broaden their knowledge and skills and develop the personal qualities required in their professional lives. CPD is therefore lifelong learning in practice.

In many European countries, CPD is a condition placed on the Technologist's continuing membership of a professional body. CPD may also serve to assist the Technologist's career development or demonstrate the Technologist's professional standing to employers and patients. Usually it is the responsibility of the professional body to implement a system of CPD. Responsibility for CPD rests with the individual Technologist who will look to employers for support in meeting their CPD obligations. Ideally employing authorities should have an obligation to assist the Technologist in achieving CPD requirements [3].

CPD policies for Nuclear Medicine Technologists differ between European countries. Usually policies will recommend a specific number of CPD points or a minimum number of hours per annum. However, it is important that the outcome of CPD should be the achievement of specific learning by the Technologist. The individual Technologist should devise an action plan or a Professional Development Plan (PDP) for their individual CPD programme as outlined in Table 1.

Table 1: Professional Development Plan Information

Professional Development Plan (PDP) Information	
Step 1	Write down: • all the tasks you perform in your current job, • the areas you need to be more knowledgeable about, • the skills you require, • any likely changes to your job within the next year.
Step 2	Consider your short and longer-term ambitions and the timescale to achieve them.
Step 3	Consider any likely problems or constraints, and the resources available for your learning.
Step 4	Start to consider and prioritise your development needs in the light of the above.
Step 5	List your CPD priorities for the next year.

It is important that the PDP is regularly reviewed and updated in line with changes in the Technologist's current work and their future plans. CPD activity should represent the personal and professional aspirations set out in the Technologist's professional development plan. This means that every course, seminar attended by a Technologist is linked to their PDP.

Typical examples of CPD activities:

- Post-qualification studies
- Short courses
- Distance learning
- Attendance at conferences or seminars
- Committee work
- Quality Assurance
- Research
- Publications
- Imparting knowledge

Recording CPD activity:

The method of recording CPD activity varies between European countries. In some countries, the professional body issues each member with an annual CPD record book. CPD activities are recorded in the CPD record book and supported by a personal portfolio of evidence of CPD activity (for example, course/seminar/conference attendance certificates).

CPD software programmes are now available, which automate the management and administration of an organisation's CPD. A major advantage of these CPD software programmes is the provision of an on-line recording capability for Technologists. Such

a system enables the professional bodies to more effectively record and monitor the CPD activities of its' members.

A commitment to CPD is essential to the work of the Nuclear Medicine Technologist throughout his or her working life. CPD benefits the Technologist by enabling a higher standard of performance. The employer benefits by the resultant higher quality service and most important of all, the patient benefits by the enhanced standard of patient care.

Section 3 – Staff Aspects of Best Practice

3.6. Multidisciplinary Team Working

Linda Tutty

A high quality service involves significant multidisciplinary teamwork. The multidisciplinary team (MDT) should provide a framework for continually striving to improve patient care and to produce accurate results in a timescale appropriate to the patients' needs. Staff from many different specialties (ideally possessing a variety of skills necessary to produce safe and effective patient care) contribute to the work in Nuclear Medicine; including doctors, radiographers, technologists, physicists, pharmacists, nurses and administrators. For a Nuclear Medicine department to run effectively, all staff need to understand each other's role within the team and to communicate effectively. Due to variations of team make-up, each department should produce its own document outlining each member's role.

Multidisciplinary teamwork is an approach designed to guide thinking and practice in the healthcare system. Characteristics such as objectivity, regularity, common goals, efficiency, a patient perspective and shared responsibility are required. In the decision-making process, each professional has a responsibility to contribute their skills and to acknowledge the goals of the department. Members of the Nuclear Medicine team should have their role well defined and understood. There should be clarity and accountability in the team. Studies have shown that when staff feel they are an integral part of the multidisciplinary team, their stress levels are reduced allowing for better patient care (1). There should be sufficient resources available to allow for good communication within the MDT and with the patient. A teamwork environment leads to employee satisfaction, which in turn leads to successful recruitment and retention of staff.

Effective teamwork is most likely to occur where each team member's role is seen as essential and where there are clear team goals (2). Other factors include effective communication, recognition of team member's professional judgment and adequate time and resources. The Nuclear Medicine team may be aided by having shared education and training sessions and by working on team development. Staff who work best in a team are not only capable of performing their own role but also possess the knowledge, skill and attitudes that support their team (3).

MDT work is influenced by organisational culture. A concise organisational philosophy on the importance of teamwork can promote collaboration by encouraging new methods of working together. Teams require training to learn how to work together and understand the role of each member. They also require an effective administrative structure and leadership.

The single best way to promote a teamwork environment is through open, prompt and constant communication. Collaboration enhances teamwork (4). Collaboration is a process that requires relationships and inter-

actions between professionals regardless of whether or not they perceive themselves as part of the team. The MDT should periodically discuss:

- Nuclear Medicine equipment and diagnostic/therapeutic needs
- Staffing needs, concerns and competencies
- Quality processes to resolve problem areas
- Turnaround times of procedures and reports based on quality audits

The benefits of the multidisciplinary teamwork within the Nuclear Medicine department may be classified as:

- A more responsive and patient-centred service
- A more clinically effective and/or cost effective service
- More satisfying roles or career paths for each profession

Nuclear Medicine can provide services to other specialty areas, so close liaison with other departments is important. In most hospitals, there may be regular clinical commitments to some specialist areas such as endocrinology, cardiology, oncology, paediatrics, neurology, nephrology and orthopaedics (5) (6). For example, departments that provide radionuclide therapy maintain close discussion with endocrinology in the treatment of benign and malignant thyroid disease. The participation of multidisciplinary team conferences in the delivery of cancer care allows for enhanced management of complex malignancies. Involvement in cross-specialty meetings is valuable for cost-effective service provision. It is essential that regular Nuclear Medicine MDT meetings are held to ensure that optimum patient management is achieved.

In addition, such a multidisciplinary approach is a necessary requisite for research applications and for further developing Nuclear Medicine techniques. With successful collaboration, a multidisciplinary team helps create and maintain an efficient and high quality Nuclear Medicine service.

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Section 3

3.1, 3.2 and 3.3

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