



ACPSEM

Australasian College of Physical Scientists & Engineers in Medicine
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**Training, Education
& Accreditation
In
Nuclear Medicine Physics**

Information Booklet

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Nuclear Medicine Physics Accreditation Panel (NMPAP)

Contents

Introduction

Training & education and accreditation: general aspects

- Education Committee

- Board / panel of examiners: Nuclear Medicine

- Training and education

- Accreditation of practicing Nuclear Medicine Physicists

Accreditation of Experienced Medical Physicists

Accreditation assessment

Application procedure

- Submission of documentation.

- Oral examination

- Processing applications

- Application fees

- Appeals process

- Exemption

Appendix 1

- Training Syllabus for Nuclear Medicine Physics

Appendix 2

- Accreditation Panel

- External Assessors

- Clinical Supervisors

Appendix 3

- Assessment of Trainee / Registrar in Nuclear Medicine Physics

Appendix 4

- Application Questionnaire

Introduction

Medical Physics is concerned with the application and development of the principles and techniques of physics to the diagnosis, treatment and prevention of human disease. The scientist entering this profession will normally have a good honours degree in physics from an Australian university or equivalent. Due to the autonomy of medical physics work in practice and highly specialised skills and knowledge required, a formal approach to the training of new entrants is necessary. In this way, a proper vocational foundation is ensured.

To achieve competence in a sub-speciality of Medical Physics a five year program of education and training is considered necessary. Training schemes generally address the fields of Radiation Oncology Physics, Nuclear Medicine and Diagnostic Radiology and Radiation Safety. However, in this document reference will only be made to Nuclear Medicine. Those candidates successfully completing the training scheme to the satisfaction of the ACPSEM Professional Standards Board, are deemed to be competent to practice as Medical Physicists in their field of specialisation. Candidates successfully completing the training scheme to the satisfaction of the PSB are deemed competent to work in their sub-specialty without supervision and will be eligible for Ordinary Membership of the ACPSEM, subject to satisfying all necessary criteria for membership. The formal assessment process of accreditation is seen as a fundamental criterion for Ordinary Member status of ACPSEM.

In this document reference is made to structures that may be implemented for general accreditation. A Nuclear Medicine Physics Accreditation Panel / Board of Examiners has been established in parallel with those already established in other sub-disciplines. The details provided for Nuclear Medicine aim to satisfy general accreditation.

Training, Education and Accreditation: General Aspects

Professional Standards Board

The Professional Standards Board (PSB) of the ACPSEM administers the accreditation scheme. Additionally an Accreditation Panel of Examiners oversees the curriculum development and examination process for each sub-specialty. The elected chairperson for each Accreditation Panel represents that sub-specialty on the PSB.

Nuclear Medicine Physics Accreditation Panel

An Accreditation Panel has been established under the ACPSEM consisting of accredited individuals who all are members of the ACPSEM. A register of accredited physicists will be maintained by the ACPSEM and made publicly available. Additional examiners will be co-opted as necessary. Such examiners must hold ACPSEM Accreditation in Nuclear Medicine Physics. Responsibilities of the Accreditation Panel are detailed in Appendix 2.

Training and education

The mechanism of providing structured education and training in medical physics has been developed by the ACPSEM. Training and education normally occupies five years and includes:

- Completion of the coursework component of an ACPSEM accredited Masters course or equivalent (or sitting an independent exam in general medical physics at Masters level)
- Completion of training modules that develop competence in various aspects of nuclear medicine physics
- Demonstration of experience in project development and /or research.

The current training syllabus for Nuclear Medicine Physicists (NMP) is provided in Appendix 1. This defines the set of competencies that should be acquired by physicists working in nuclear medicine and forms the basis for a set of defined tasks that trainees / registrars in nuclear medicine should complete. The mechanisms for undertaking education and training are outlined below.

Accreditation of experienced Nuclear Medicine Physicists

This document also provides advice for medical physicists currently working in Nuclear Medicine and outlines the accreditation procedures applicable to this group. The objective of the accreditation procedure is to verify that individuals have at least equivalent expertise to those that would undertake accreditation examination on completion of the training and education scheme. Accreditation is therefore closely linked to the proposed syllabus for training in Nuclear Medicine Physics.

This mechanism for gaining accreditation will cease at the end of 2010.

Implementation of the training and education scheme

General education

Nuclear Medicine Physicists should have a basic degree in Physics or Engineering (or equivalent) and should then complete the coursework component of an accredited Medical Physics Masters program, which is normally assessed by formal examination. Persons who have not completed a general course will be expected to sit examinations in general medical physics at Masters level. The coursework component will normally occupy one year. Trainees are expected to undertake a research project so as to complete a postgraduate degree (either Masters or PhD). Completion of a PhD may extend beyond the period of training. Note that persons who have not completed a relevant first degree will not be accredited unless they have undertaken an appropriate bridging course.

In-service training

Trainees in Nuclear Medicine must gain experience in a clinical department for a period not normally less than three years, and commonly for four years. During this period the trainee would normally be assigned clinical duties or projects under supervision, which

would develop general skills. However the trainee will also be expected to complete a program of formal training following the nuclear medicine training syllabus. A set of modules is available which define tasks that expose the individual to the expected advanced knowledge and competencies that are assessed as a requirement of accreditation. The training syllabus is expected to occupy 2 years but can be completed over an extended period. In addition the trainee must undertake and document research or development projects occupying further 2 years. Research work undertaken as part of the requirements for a postgraduate degree may be eligible (provided at least one year is in a clinical setting).

Applications

Trainees registering with the ACPSEM need to demonstrate their eligibility at the time of application and identify a clinical supervisor (an accredited nuclear medicine physicist preferably, but not necessarily, working in the same department as the trainee). The trainee and clinical supervisor must present a training plan that confirms the trainee has access to time and resources to undertake the training program (verified by the head of department) and verifies the availability of the supervisor. An external assessor will be appointed to oversee the individual trainee's progress, with responsibility to report back to the Accreditation Panel (see Appendix 2 for details). A fee is payable for persons undertaking the complete training program (which includes the accreditation fee normally charged). Fractional fees will be defined for individuals undertaking only part of the training program. Advice on fee structure will be supplied separately. Applications should be submitted to the ACPSEM General Manager who will forward the documents to the persons responsible for coordinating the training program. Approval from the ACPSEM should be obtained before commencing a training program.

Advice to trainees / registrars

The aim of the competency modules that have been developed is to assist trainees in gaining the breadth of experience necessary to take a position of responsibility in nuclear medicine physics. The modules are designed to guide the trainee through a set of tasks that have been designed to expose the trainee to the requisite skills and knowledge base. Many modules specify the documentation required of the trainee. In general, documentation should provide evidence of the material reviewed and/or work performed in completing the module. This documentation can be quite concise. Documentation of the modules completed will result in a portfolio that records the range of experience, which would normally meet accreditation requirements. Trainee progress will be monitored at least monthly by their clinical supervisor and assessed more formally at least once per year by their external assessor. The research component of the training should be written up in the format of a submission to a journal. If the research was performed as part of a MSc project, the MSc thesis will suffice. Trainees completing the training program and documenting their work would therefore be expected to be eligible for accreditation, provided they have worked in a clinical department and had opportunity for project development and /or research for the required period. Trainees should therefore regard the program as a means of aiding their development of competencies rather than as a continual test of their ability. Trainees who encounter difficulties or require additional information or advice should contact the Nuclear Medicine Training

Coordinator - details of the current Nuclear Medicine Training Coordinator can be found on ACPSEM website.

Accreditation of experienced Nuclear Medicine Physicists

This mechanism for gaining accreditation will cease at the end of 2010.

One of the main objectives of the accreditation scheme is to encourage the adoption of a standard training syllabus. Persons who successfully complete training and meet requirements for accreditation demonstrate their ability to undertake unsupervised work.

To establish an initial Panel of Examiners applications were sought from individuals who could demonstrate that they had at least *20 years full-time equivalent* experience in Nuclear Medicine (with experience in areas other than radiation safety). Accreditation in Radiation Safety is the responsibility of a separate Board of Examiners. Initial applicants were members of both ACPSEM and ANZSNM. The initial set of six applications was evaluated by the group of applicants and all candidates undertook oral examination. Consensus was reached regarding the suitability of the applicants to be awarded accreditation and recommendations based on this consensus were forwarded to the College for approval. The College has approved the accreditation of this group and their appointment to the Panel of Examiners.

Physicists who have worked in Nuclear Medicine for a lengthy period will normally be able to demonstrate evidence of meeting most of the criteria for accreditation in addition to the development of more advanced skills. For an initial period, applications for accreditation were sought from suitably experienced individuals with at least 10 years full-time equivalent experience. Assessment of these applications was judged on the basis of individual CV and completion of a questionnaire that documented past experience and current practice. In addition candidates undertook an oral examination, at which they were required to demonstrate evidence of documentation and give a presentation on their work.

Applications are now sought from individuals with at least *5 years full-time equivalent* experience in Nuclear Medicine. As before applicants will be assessed by the Panel of Examiners and candidates who provide sufficient evidence of meeting the accreditation criteria will undertake an oral / practical assessment. Applicants with less than 10 years experience will be expected to provide electronic copies of documentation demonstrating how they meet the requirements of the syllabus, at the time of application. If deemed necessary by the Examiners, a site visit may also be conducted as part of the candidate's assessment. The Panel of Examiners will advise where exemption is granted for sections of the syllabus based on demonstrated experience. Applicants will be expected to complete selected modules in the formal training program to complement previous experience.

Accreditation assessment

In the following the assessment procedure is defined for new trainees who have completed the proposed training program in nuclear medicine physics. An alternative method of assessment is defined for individuals who already work in nuclear medicine. See also Appendix 3 for further details.

- a) Portfolio evidence of work undertaken in each of five key areas (5*10 marks). Adheres to defined competencies in syllabus; selection of documentation inspected by examiners. **50**

Alternative:

Documented evidence of previous work undertaken in five key areas with addition of teaching and management experience (full CV and completed questionnaire). Some latitude will be given for areas where documentation is unavailable but alternative experience demonstrated.

- b) Formal oral assessment on application of medical physics to clinical practice. Candidates will elect an area of clinical application and must demonstrate awareness of physical aspects including instrumentation (planar, SPECT and PET), computing (acquisition and processing) and radiation safety considerations. The candidate will be expected to be aware of current practice and potential sources of artefact or error. Candidates will be expected to provide evidence of particular expertise or experience in the selected area of application (e.g. relevant publications or reports). **25**

Alternative:

All applicants must undertake this formal assessment and provide relevant evidence of experience.

- c) Presentation on research / development topic¹ plus record of publications, presentations and grants. On completion of basic training candidates must have either one peer reviewed publication as first author or 3 peer reviewed publications as co-author. The candidate should also have presented their own work to at least 2 meetings (at least 1 at a national or international level). **25**

Alternative:

Evidence of more extensive research and development demonstrated by publication, presentation, grants, project/ student supervision. The candidate should have at least 3 first author publications or 10 co-author publications and have presented work to at least 6 meetings.

Expected pass level

75

It is expected that the College Office will maintain the following records of candidates:

¹ Note that the research / development topic should be directly relevant to nuclear medicine.

- i) Copy of CV with details of publications, degrees held etc
- ii) Record sheet outlining level of competency, completed by candidates and countersigned by clinical supervisor or external assessor.
- iii) List of documentation available to support basic competency, with selected documents verified by examiner
- iv) Score sheet for oral assessment of application in clinical practice
- v) Score sheet for research presentation / documented research & development experience

Application procedure for experienced Nuclear Medicine Physicists

Submission of documentation.

Candidates should submit a formal request to the General Manager of the ACPSEM to apply for accreditation. This should be accompanied by (preferably in electronic format):

- a) a full curriculum vitae;
- b) the completed application form (see appendix 4), in which details of the candidate's level of experience are documented. Applicants should include, in the spaces provided for each clinical area of expertise, references to any reports, investigations, publications and other work related experience sufficient to convince the examination panel that the candidate has the depth and breadth of experience required.
- c) a copy of each item of supporting documentation in electronic format (applicants with less than 10 years experience only). Each document must be numbered and referred to by this number on the application form.
- d) a signed statement from their Head, Chief or Director attesting to the accuracy of the documentation provided.

The General Manager will forward electronic copies of the application to the Chair of the Nuclear Medicine Physics Accreditation Panel. The Accreditation Panel Chair will in turn circulate the application to all Panel Members for comment. If, in the opinion of the majority of Panel Members, the candidate appears, on the basis of the material submitted, to satisfy the minimum requirements for accreditation, he /she will be invited to participate in the formal assessment process. The General Manager and Chair of the PSB will be notified of the outcome of the assessment.

Oral examination.

All candidates must undertake an oral examination, which may include a practical component. Candidates will be required to bring with them any further documentation requested by the Examiners before the examination, and to give a formal presentation on their work. Oral examination questions will be framed so as to allow candidates to demonstrate the following in respect of their chosen clinical area:

- Awareness of physical aspects of instrumentation (PET, SPECT, Planar)
- Computing expertise
- Awareness of radiation safety considerations
- Awareness of current practice
- Awareness of potential sources of artifact and error
- Research achievement

If deemed necessary by the examiners, a site visit may be conducted in conjunction with the oral examination. Under these circumstances, information obtained from the candidate during the site visit will supplement information obtained during the oral examination and both will contribute to the final mark awarded to the candidate. Nominated referees may also be contacted if deemed necessary to verify experience gained.

*Oral Examination Procedure for NM Physics Accreditation
(Experienced Nuclear Medicine Physicists)*

1. Wherever possible the Accreditation Panel will endeavour to arrange a mutually suitable examination date and venue with the candidate. The candidate will be formally notified of the examination date and venue at least 2 weeks prior to the exam.
2. At least three examiners are required to partake in the examination. Examiners must be Members of the Nuclear Medicine Physics Accreditation Panel. Examiners should bring with them the copy of the candidate's application which they were sent at the time of the application.
3. Where the examiners believe it is necessary to examine further documentation to verify (a) the candidate's experience and expertise, or (b) the candidate's eligibility for Accreditation, the candidate will be requested at least 7 days before the examination date to supply such information to the Chair of the Accreditation panel or nominee.
4. A Chairman of the Examination Panel will be nominated by the Accreditation Panel prior to the exam.
5. The candidate will be asked to nominate ONE of the following five clinical areas, i.e. (a) Cardiology, (b) Neurology, (c) Oncology, (d) Renal and GIT, OR (e) Endocrinology.
6. The candidate will be asked to present an overview of his/her experience in and contribution to the chosen clinical area.
7. The examiners will ask questions designed to assess the candidate's general knowledge and experience in the nominated clinical area, and, if deemed necessary, may question the candidate on other areas.
8. At the conclusion of the examination the candidate will be informed that the outcome will be advised by the College Office. The examiners will discuss the outcome after the candidate has left the room.

9. If the decision of the examiners is not unanimous, a vote will be taken. The Chairperson of the Examination Panel will not participate in this vote. If the vote is equally split, the Chairman of the Examination Panel will have the casting vote.

10. The Accreditation Panel Chair will promptly advise the College Office of the outcome.

Overall Assessment

The candidate's overall accreditation assessment mark shall be comprised of:

Documentation	50%
Research	25%
Oral	25%

The research mark will be based on evidence provided to the examiners via documentation, the site visit (if undertaken) and oral assessment.

Processing applications.

The number of candidates in any given year is limited by the available resources. Candidates are queued strictly in the order in which their documentation is received by the General Manager. Consideration of applications will be at the discretion of the Chairperson of the Professional Standards Board in consultation with the Chair of the Nuclear Medicine Physics Accreditation Panel. Failure to provide sufficient documentation removes the applicant from the queue and requires a fresh application. Candidates, once notified that the application is accepted, will have four weeks to send the balance of the fee to the General Manager. If the fee is not received by this time, the General Manager will send notice giving one week's grace. After this period the examination position may be allocated to the next person in the queue. They will similarly have four weeks to forward fees.

Application fees.

For candidates in Nuclear Medicine the fee will be the current fee as specified by the ACPSEM. Part of this will be a non-refundable application fee.

General advice applicable to both trainees and experienced nuclear medicine physicists

Appeals Process.

The candidate may appeal against a decision of "not of required standard". Such appeal must be lodged within two weeks (10 working days), of receipt of the confirmed results of the examination. The appeal must be made in writing giving full reasons for appeal together with appropriate evidence and sent to the General Manager.

Exemptions.

Applicants for accreditation must normally have at least five years experience in Nuclear Medicine including evidence of formal examination in general medical physics (e.g. completion of a relevant Masters by course work). Applicants should have undertaken work covering all aspects of nuclear medicine as outlined in the syllabus (appendix 1).

Applicants must also demonstrate that they have had research experience, normally demonstrated by published and presented work. Allowance will be made for previous relevant experience gained normally through postgraduate study, not exceeding the following guidelines. Any claim for exemption must be approved by the Nuclear Medicine Physics Accreditation Panel prior to assessment. Table 1 provides indicative exemptions for various situations.

Accredited courses

A number of Masters courses in Australia and NZ have been accredited by the ACPSEM to satisfy the coursework component of the training and accreditation scheme. Where individuals have either a research Masters or PhD they will still be required to satisfy the accreditation panel that they have passed exams at Masters level covering the syllabus in general medical physics.

Department accreditation

There is no department accreditation required for nuclear medicine training. Instead the individual trainee and clinical supervisor must jointly submit a training program with confirmation that any necessary resources can be readily accessed either in the trainee's department or elsewhere. This should be verified by the head(s) of department.

Table 1:

New trainees in Nuclear Medicine will be expected to undertake specific education and training typically over 5 years, including 1 year equivalent of general medical physics education (to Masters equivalent level), 2 years of clinical practice and 2 years of experience in research and development. The following table provides indicative exemption based on the entry qualification of the candidate (subject to individual assessment by the nuclear medicine accreditation panel).

Prior Qualification	General education	Clinical practice		Research² Experience	
BSc Hons (Medical Physics)	may include replacement electives	✓	✓	✓	✓
MSc coursework (accredited)	<i>exempt</i>	✓	✓	✓	✓
MSc research (in relevant speciality)	✓	✓	✓	✓	<i>exempt</i>
PhD (topic not relevant)	✓	✓	✓	✓	<i>exempt</i>
PhD (relevant, hospital based)	✓	✓	✓	<i>exempt</i>	<i>exempt</i>
Prior accreditation in other subspecialty	<i>exempt</i>	✓	✓	✓	<i>exempt</i>

² Note that at least one year of research experience should be based in a clinical nuclear medicine department.

Appendix 1

Training and Competency Syllabus for Nuclear Medicine Physics

(v. 2_4 April 2005)

The following syllabus details the competencies that are expected of individuals applying for accreditation. In the clinical subject areas competencies are specified at two levels (basic and advanced), corresponding to the training syllabus.

Radiation Safety and Dosimetry

Basic Level

a) *Monitoring radiation levels*

Topics: External radiation hazards and internal radiation hazards. Measurement of area dose rates, surface contamination, personnel dose (external and internal). Radionuclide identification. Safe handling and storage of sources.

Competency: Able to select and use appropriate monitoring, including

- Portable and fixed area monitors for photon dose rates and surface contamination
- Personnel dosimeters – passive and electronic
- Meaning of operational dose quantities
- Calibration procedures
- Assay of biological samples

Able to carry out a radiation survey of a laboratory or clinical area, including

- Identify any areas of radioactive contamination or elevated dose rate, identify the radionuclide and cause
- Identify any instances of unsafe practices or facilities
- Advise on safe handling and storage of radionuclides
- Write a report

b) *Reducing external exposure levels and the risk of contamination*

Topics: Area radiation monitoring, shielding, restrictions on contact with patients Radiation spills and emergencies, decontamination, incident reporting

Competency: Able to identify locations or practices where radiation exposure could reasonably be reduced
Able to identify locations or practices where spills may occur and how to reduce the risk
Able to respond to a radioactive spill

- Critically assess facility layout and shielding and recommend cost effective changes including shielding design

- Estimate dose rates near patients and influence of patterns of close contact
- Implement measures to reduce dose from contact with radioactive patients and other sources
- Train staff in responding to a spill including the use of a spill kit
- Decontaminate persons or the workplace after a spill
- Assess residual contamination levels in the workplace and recommend restrictions and remediation measures
- Assess dose to contaminated persons and recommend further actions
- Prepare a report on significant incidents, including dose estimations and recommendations to avoid a similar incident in future

c) ***ALARA and radiation safety precautions for performance of a diagnostic procedure.***

Topics: Protection of health care workers and the public from radiation used in nuclear medicine diagnostic procedures

Competency: Able to demonstrate how to keep radiation dose in nuclear medicine to a reasonable level, through knowledge of

- Dose limits and dose constraints for occupational and public exposures
- The typical radiation doses to health care workers and others in a well-managed practice

Able to prepare and implement appropriate radiation safety measures for the performance of diagnostic examinations

- Critically review the precautions for existing procedures
- Develop precautions for a new procedure
- Prepare Information Sheets for patients/carers for specific clinical applications, addressing such issues as periods of close contact with children, breast feeding and urinary incontinence.
- Identify situations where extra precautions are advisable
- Plan a workplace and procedures to avoid unnecessary exposures

d) ***Radiation dose from diagnostic nuclear medicine radiopharmaceuticals***

Topics: Radiopharmaceutical radiation dose, reference activities, paediatric factors

Competency: Able to make generic radiation dose assessments including

- Reliable sources of dosimetric data
- Adjustments for activity, age, weight, simple physiology
- Effective dose
- Fetal dose
- Reference activities

e) ***Advice to staff, patients and others regarding radiation risk***

Topics:	Natural background radiation levels, biological effects of ionising radiation, ICRP radiation detriment coefficients (1990 and 2005)
Competency:	<p>Able to communicate risk or lack of risk in context of dose, justification and relevant non-radiation risks</p> <p>Able to produce a dose report for diagnostic procedures in individual patients</p> <ul style="list-style-type: none"> • Relate occupational exposures in nuclear medicine to other occupational risks and to variations in natural background. • Assess the risk and recommend precautions for women who wish to continue working in nuclear medicine while pregnant • Determine the risks to patients of any age from the radiation exposure associated with their nuclear medicine procedures • Prepare a report for the physician of a patient who had a diagnostic procedure when unaware that she was pregnant at the time, including comment on the fetal dose, any likely consequences and comparison with the normal risks of pregnancy.

Advanced Level

a) Regulatory controls and other guidance on the safe use of ionising radiation in nuclear medicine

Topics:	<p>Relevant legislation from State departments of health, environment, occupational health and safety</p> <p>National Standards, Codes of Practice and Guidelines from ARPANSA, Standards Australia and professional bodies</p>
Competency:	<p>Able to determine the legal requirements and guidance, including</p> <ul style="list-style-type: none"> • The regulatory requirements in the trainee's own State • The guidelines issued by national agencies which are relevant to nuclear medicine <p>Able to critically assess the Radiation Safety Programme in the trainee's institution and to prepare a report identifying any areas of non-compliance with the law</p> <p>Able to generate and maintain a system for keeping radiation safety records for a nuclear medicine department including</p> <ul style="list-style-type: none"> • Personnel dose • Radiation licences and registrations • Radiation incidents • Radioactive materials including wastes

b) Radiation safety precautions for therapy using unsealed radionuclide sources

Topics:	All aspects of the safe and accurate administration of therapy radiopharmaceuticals and the subsequent care of the patient
Competency:	Able to recommend safety procedures for radionuclide therapies including

- Correct ordering of dose, verification of correct radiopharmaceutical and prescribed activity
- Identification of patient, pregnancy status and correct preparation for therapy
- Treatment as inpatient or outpatient
- Information for patients and their families/carers
- Appropriate inpatient facilities including radiation monitors
- Instructions to nursing and other staff
- Monitoring of the patient, waste materials, laundry and bedroom/bathroom
- Discharge of patient with suitable advice on subsequent precautions

c) *Areas designated for the use of unsealed radioactive materials*

Topics: Radionuclide hazard groups, grading of laboratories and other premises, construction standards, fit-out and finishes.

Competency: Able to prepare design specifications for a radioisotope laboratory and clinical areas for diagnostic and therapeutic nuclear medicine applications

- Grade premises depending on the radionuclides, activities and operations according to AS2243.4
- Specify construction requirements for unsealed sources used in
 - the preparation, dispensing and administration of radiopharmaceuticals
 - inpatient radionuclide therapies
- Specify construction requirements for CT installations in combination with radionuclide imaging
- Specify construction requirements for a long-term radiation store holding sealed and unsealed sources

d) *Calculation of radiation dose from a new radiopharmaceutical*

Topics: MIRD system and software, ICRP Reference Man

Competency: Able to obtain data and calculate a generic dose estimate

- Use biokinetic data (acquired or published) for a radiopharmaceutical to identify 'source organs' and determine their cumulative activity
- Calculate the absorbed dose to all organs and tissues and the effective dose, using MIRDOSE or OLINDA software.

e) *Radiation safety assessment of a nuclear medicine research protocol*

Topic: Dose estimation, risk communication, guidelines and approval for nuclear medicine research protocols

Competency: Able to assess and report on a research protocol

- Describe the process for obtaining approval to conduct a research study involving exposure of subjects to ionizing radiation.
- Explain the dose constraints and other recommendations in the national Code of Practice
- Obtain or verify dose estimates for radiation procedures in a research protocol which are additional to those required for clinical management
- Prepare a radiation safety report to the HREC.

Instrumentation and QC

Basic Level

a) *Gamma camera planar and SPECT QC procedures*

- Topics: Planar QC - spatial resolution, uniformity
SPECT QC – centre of rotation, spatial resolution, uniformity
- Competency: Demonstrate ability in performance, documentation and interpretation of gamma camera QC procedures including:
- Spatial resolution
 - Uniformity (integral & differential)
 - SPECT centre of rotation measurement
 - SPECT spatial resolution
 - SPECT uniformity

b) *Gamma camera calibration*

- Topics: Uniformity correction, energy correction, linearity correction
- Competency: This competency is designed to
- Demonstrate knowledge of the mechanisms, purpose and importance of energy, linearity and uniformity correction calibrations and the effects of incorrect calibrations.
 - Demonstrate knowledge of the potential impact and applicability of the corrections if a range of different radioisotopes are being used.
 - Be able to perform appropriate tests to demonstrate that the corrections are appropriately applied and working correctly.

c) *Trouble shooting of camera and QC problems*

- Topics: Crystal defects, collimator defects, PMT malfunction, ADC problems, mechanical problems, instrument setting problems
- Competency: Demonstrate ability to trouble shoot gamma camera and QC related problems and artefacts including the following:-
- Recognize artefacts and problems on gamma camera QC
 - Be able to perform appropriate tests to determine the cause or source of the artefacts
 - Determine whether the gamma camera can be used clinically with the problem
 - Recommend corrective action to be taken
 - Perform appropriate tests to ensure the action has solved the problem

d) *Parameters influencing gamma camera performance*

- Topics: Planar and SPECT spatial resolution as a function of source distance and collimation, scatter fraction, sensitivity
- Competency: Be familiar with parameters which can affect image quality and be able to carry out experiments which demonstrate the effects including:

- Source distance from collimator face on spatial resolution
- Depth of source in the object on SPECT spatial resolution (radial and tangential)
- Effect of parallel versus fan beam collimation on SPECT spatial resolution and sensitivity
- Effect of object thickness and density on scatter fraction

e) ***Dose Calibrator QC procedures***

Topics: Constancy, background checks, linearity and accuracy.
Effect of geometry and energy and type of emissions on radioactivity measurements.

Competency: Demonstrate understanding and perform basic dose calibrator QC including:-

- Constancy, background, linearity and accuracy checks
- Requirements and evaluation of ANZSNM TSSC dose calibrator survey results

Demonstrate understanding of factors which can affect dose calibrator readings and be able to determine appropriate corrections for:

- Effect of geometry
- Effect of energy and types of emissions from the radioactive sample

f) ***Display and Hardcopy Devices***

Topics: Display and film characteristics, gamma corrections, test patterns (eg.SMPTE)

Competency: Understand factors affecting image quality on display monitors and hard copy including:

- Knowledge of film and other hard copy properties and calibration
- Ability to test and calibrate display used for reporting
- Familiarity with the way display window settings and grey scale maps affect image display.

Advanced level

a) *Compare equipment performance as a basis for system purchase*

Topics: Performance specifications, NEMA standards, IEC standards

Competency: Demonstrate familiarity with the processes involved with comparing system performance as a basis for system purchase including the ability to:-

- Determine the type of gamma camera required for the department
- Produce a specification document which lists the minimum required performance specifications (based on NEMA and/or IEC tests) for a gamma camera
- Obtain the relevant specifications of currently available commercial systems from the vendors and compare them based on the specification document
- Document the results of the comparison and a recommendation for purchase or a ranking of the eligible systems

b) *Acceptance tests for a gamma camera with SPECT and whole body scanning capability*

Topics: Acceptance testing, gamma camera and SPECT performance reporting and compliance

Competency: Demonstrate ability to:

- Design a set of acceptance tests to be performed on a gamma camera system following its commissioning which determine whether the camera meets required performance specifications.
- Perform acceptance tests on a SPECT system with whole body scanning capability
- Produce a report which shows the results of the acceptance tests, flagging any non compliances (based on your original minimum performance specifications) and indicating whether the system should be accepted for routine clinical imaging

c) *Supervision of a routine QC program*

Topics: Gamma camera and SPECT QC, establishment and supervision of QC program

Competency: Demonstrate ability to devise and supervise a routine QC program including:-

- Design of a routine QC protocol for a clinical SPECT system, including the frequency and method of measurement, as well as how the results should be recorded and periodically reviewed
- Determine the minimum acceptable performance to allow clinical imaging to proceed on a given day and the triggers (and reporting mechanism) that should initiate first line trouble shooting
- Document the QC protocol in a form for technological staff to follow

d) ***Quantitative Gamma Camera Measurements***

Topics: Efficiency, attenuation, scatter, partial volume effect, activity/cross calibration

Competency: Demonstrate understanding of factors affecting quantitative measurements in nuclear medicine including

- Gamma camera and collimator efficiency
- Attenuation
- Scatter
- Partial volume effects
- Activity/cross calibration

Demonstrate ability to achieve quantitative measures from planar and SPECT studies including:-

- Estimation of planar activity
- SPECT quantification and activity/cross calibration factor

e) ***PET Instrumentation***

Topics: Principles of PET, PET instrumentation technologies, PET performance and instrument requirements and selection, PET quantification

Competency: Demonstrate an understanding of :

- PET instrumentation and PET imaging fundamentals
- PET performance characteristics and their importance for PET image quality
- Range of PET technologies available and their advantages and limitations
- PET corrections, calibration and activity quantification
- Performance requirements for high throughput and high quality whole body studies

f) ***SPECT/CT and PET/CT Instrumentation***

Topics: Principles of CT for attenuation correction of SPECT and PET, radiation dose consideration in SPECT/CT and PET/CT.

Competency: Demonstrate an understanding of :

- Use and limitations of CT for attenuation correction in SPECT and PET

Able to assess CT technique factors, estimate a “standard adult” dose and modify CT factors for age and weight

- Calculate CT dose indices and effective dose
- Recommend age- and weight- specific CT technique factors for SPECT/CT and PET/CT studies
- Compare total dose from SPECT/CT and PET/CT imaging with dose from standard CT for diagnostic radiology

Computers and Image Processing

Basic level

a) *Demonstrate familiarity with the operation of a clinical workstation*

Topics: Patient selection, image display, basic instruction set for display, simple image processing, curve and ROI tools, data transfer, macro program development

Competency: Able to demonstrate basic skills required for workstation usage including:

- Effectively use a workstation menu system, keyboard shortcuts, mouse, and help facility
- Define scan protocols and acquire different types of scan
- Locate patient studies and demonstrate ability to perform simple image display tasks, e.g. window and threshold, layout, resize, smooth, cine, annotate, plot, screen grab
- Perform manual analysis of common types of clinical data
- Reconstruct tomographic data with appropriate selection of parameters
- Transfer clinical data between workstations
- Archive clinical data to removable media
- Use macro or batch facility as available to automate a process, e.g. simple clinical analysis or file manipulation
- Take appropriate action when problems arise

b) *Perform basic computer system administration tasks*

Topics: Basic administration of a common computer system (PC, Mac, Unix)

Competency: Able to demonstrate familiarity with and ability to perform common basic system administration tasks, including:

- Identify system hardware components and software (processor type and speed, RAM, disks, disk partitions, operating system version, clinical software version, IP address)
- Log in with administrator privileges
- Observe proper startup and shutdown procedures
- Remove and re-install external peripheral storage devices observing proper procedures, e.g. static electricity precautions, SCSI rules
- Install operating system
- Perform basic troubleshooting:
 - Use on-line and web-based sources of system documentation
 - Check available disk space
 - Determine space occupied by individual files and folders
 - Identify recently-created/modified files
 - Identify CPU and memory usage of individual processes
 - Terminate a process

- Check basic network connectivity
- Monitor print queue
- Access and interpret messages in system log files
- Compress and decompress files and folders
- Install application software
- Connect from a remote computer
- Set up a printer
- Create a new user account
- Compress and decompress files and folders
- Install new application software
- Manage virus protection software
- Perform system backup
- Restore files from a backup

c) *Perform first line trouble shooting*

Topics: Data acquisition checks (timing, image quality), basic network protocols and principles, network integrity, recovering data, problem solving (decide if software or hardware)

Competency: Effectively troubleshoot common computer problems, including

- Reliably identify and distinguish between software, hardware and networking problems.
- Follow appropriate protocols to diagnose and resolve each of the above classes of problem, involving other staff and external service providers as appropriate.
- Recognize the signs of developing hardware problems.
- Be familiar with the weaknesses and strengths of common operating systems and applications software
- Access and interpret system log files and error messages to aid diagnosis.
- Use built-in documentation and diagnostic tools
- Utilize internet support resources to access bug reports, work-arounds, and obtain and install patches and software updates
- Obtain information about computer viruses and use this information to implement appropriate virus protection measures, and respond effectively to virus outbreaks

d) *Develop programs for image analysis in a high level language*

Topics: Algorithm basics, decisions, looping, etc. Use of a high level language (C, C++, Java, IDL, Matlab)

Competency: Able to develop simple analysis programs in a higher level language.

- Demonstrate ability to devise a working algorithm for a simple task in flowchart language
- Develop simple programs in a high level language (e.g. C, C++, Java, IDL or Matlab).

- Write clearly, making appropriate use of available language constructs and facilities
- Test new software thoroughly
- Write efficient and readable code
- Document appropriately including use of comments

Advanced level

a) *General techniques applied in computer processing of medical images and the underlying physical principles*

Topics: Digital image processing techniques commonly applied in nuclear medicine.

Competency: Demonstrate understanding of common image processing techniques including:

- Create functional images from dynamically acquired data
- Fit curves to observed data using least squares fitting techniques
- Perform histogram modification to enhance image interpretation
- Enhance images by applying filters in the spatial and frequency domains

b) *Principles involved in advanced processing of nuclear medicine images*

Topics: Advanced digital image processing techniques commonly applied in nuclear medicine.

Competency: Understand and be able to perform advanced nuclear medicine image processing techniques including:

- Tomographic image reconstruction
- Image registration
- Tracer kinetic modeling
- Attenuation correction
- Scatter correction

c) *Develop clinical application software in a high level language*

Topics: Further development of programming extending to processing of multiple dimensional data, emphasis on data formats, user interface, automation

Competency: Be able to develop analysis programs for clinical use, which will require demonstration of

- Familiarity with a macro or other high-level programming facility on a nuclear medicine workstation
- Ability to implement a specified clinical analysis procedure in this high-level language
- Ability to produce high quality technical and user documentation for the procedure developed
- An understanding of weaknesses in the protocol and potential sources of error

d) *Standard image file formats used in Nuclear Medicine*

Topics: Interfile, DICOM, general formats, data conversion, other modalities

Competency: Be able to confidently use and manipulate medical image data in a range of standard and non-standard formats.

- Demonstrate ability to read, display and manipulate medical image data provided in commonly used formats.
- Demonstrate an understanding of the significance of storage format options for integer, float, textual and other data.
- Demonstrate an understanding of the relative advantages and disadvantages of the different image file formats for specific applications

e) ***Validate software using simulations, phantoms and clinical data***

Topics: Monte Carlo and general simulation techniques, software phantoms (Zubal, Hoffman, MCAT), statistical analysis

Competency: Be familiar with use of common Monte Carlo simulation packages and phantoms for the generation of simulated tomographic projection data, demonstrating the following:

- Ability to select appropriate simulation parameters and perform simulations
- Awareness of the range of available packages and phantoms
- Awareness of any limitations of these tools and differences that might be expected compared with real data

f) ***Advanced system management***

Topics: More advanced knowledge of system level commands (e.g. Unix), organisation of file structures, system security, management practices

Competency: Able to perform advanced system management tasks, by demonstrating

- a detailed understanding of procedures for data backup and restoration
- an advanced level of familiarity with system commands and utilities
- familiarity with use of script languages to automate system administration tasks
- an understanding of system security measures
- ability to document system management procedures

g) ***Advanced computer networking principles***

Topics: Networking hardware (cables, switches, routers, hubs, firewalls) data communication protocols, routing, DNS, network testing, security, packet filtering

Competency: Perform advanced networking tasks and demonstrate familiarity with

- Network hardware components
- Network communication protocols
- Common network protocols encountered at user level, e.g.
 - Name service
 - Mail
 - FTP
 - TELNET
- Network management and troubleshooting

- Network security

Clinical Applications

Basic level

a) *List protocols for routine clinical procedures*

Topics: Clinical diagnostic imaging applications

Competency: Able to understand and justify the technical factors of the clinical procedures used in the Nuclear Medicine Department including:

- Identification of the technical factors which influence the acquisition, processing and display of the required clinical information
- Optimisation of the acquisition parameters to maximise the clinical information
- Optimisation of the processing parameters to maximise the clinical information
- Design and implementation of a new clinical procedure based on published techniques

b) *Recognise common artefacts in clinical images*

Topics: Routine clinical diagnostic imaging applications

Competency: Able to correctly identify common artefacts in nuclear medicine images and to recommend appropriate preventative and remedial action, including:

- Identification of artefacts in nuclear medicine images
- Identification of probable causes of these artefacts
- Undertake remedial action to correct the problem giving rise to the artefact
- Optimisation of the data acquisition procedures to prevent the artefacts occurring

c) *Perform analysis of common clinical studies and describe the sources of error*

Topics: Routine clinical diagnostic imaging applications

Competency: Perform analysis for common clinical studies and describe the sources of error. For each study type:

- determine whether it has been validated in the clinical arena, and the limitations of the validation study
- investigate the effect of the scan result on patient management
- assess consequences of an inaccurate scan result

d) *Participate in a clinical research project*

Topic: Should be selected in consultation with the mentor and local medical staff

Competency: Demonstrate evidence of their involvement in a clinical research project. This may include software development, data acquisition or

analysis or statistical analysis. The results of the research should be presented or published.

Advanced level

a) *Demonstrate an understanding of the principles and physiological basis for common clinical studies*

Topics: Selected clinical investigations

Competency: Able to explain the principles and physiological basis for common clinical investigations, and be able to translate this knowledge to the development of new investigations. This will include:

- Be able to read the literature relating to a range of clinical investigations and from this, be able to implement or develop new methods to measure physiologically important parameters.
- Identification of the impact of disease and altered physiology on quantitative parameters measured using nuclear medicine techniques.
- Understanding how drugs are used for the enhancement and blocking of uptake in certain imaging protocols.
- Understanding the common reasons for patients to be referred for the clinical investigations.

b) *Develop a clinical protocol for the estimation of patient dosimetry.*

Topics: Data acquisition for patient dosimetry

Competency: Able to develop and validate a protocol for the estimation of the radiation absorbed dose to the critical organs following administration of a new diagnostic radiopharmaceutical in compliance with US FDA requirements.

c) *Demonstrate an understanding of the principles of radionuclide therapy*

Topics: Radionuclide therapy and radiobiology

Competency: Able to explain the principles and physiological basis for common radionuclide therapies, including:

- The influence of the choice of radiolabel
- Tumour radiobiology and normal tissue tolerances
- Radioiodine therapy
- Palliation of bone pain
- Therapeutic use of radiolabeled antibodies
- Treatment of liver tumours using labelled lipiodol or radiolabeled microspheres

d) *Demonstrate an understanding of the principles and physiological basis for common PET and PET/CT studies*

Topic: PET clinical applications

Competency: Able to explain the principles and physiological basis for common PET studies, including:

- The mechanisms of uptake of FDG into normal tissues and tumours

- The assumptions of the SUV method and its relationship to the autoradiographic method
- Outline clinical protocols for FDG brain, heart and whole body imaging for cancer
- The role of and typical parameters for CT in PET/CT clinical studies
- Radiation safety and patient dosimetry for PET/CT studies
- Recognise the normal appearance for brain, heart and whole body studies as well as common abnormal appearances and artifacts

Appendix 2

Accreditation Panel, External Assessors and Clinical Supervisors for Nuclear Medicine Physics Accreditation

Accreditation Panel in Nuclear Medicine Physics

The Accreditation Panel is established on the principles laid out by the ACPSEM Council in 2002 (“Accreditation Processes”³ – file “ACCREDITATION PROCESSES (mod by Council 2002).doc”).

The Accreditation Panel is responsible for making recommendations through the Professional Standards Board to Council. These responsibilities include:

- Overall responsibility for the training and accreditation program
- Establish methods and criteria for assessing training programs and candidates (from the clinical supervisor & external assessor and the final report)
- Responsibility for the overall assessment process:
 - One member assessing each registrar in the Final Assessment with the External Assessor and the Clinical Supervisor.
 - Making a final recommendation to Council as to whether the registrar should receive accreditation in radiation oncology medical physics.
- Maintaining training & accreditation records for each registrar
- Monitoring & reporting on the performance of the training & accreditation program and recommending changes to the Education Committee
- Training external assessors

It is suggested that the Panel consists of no more than nine to twelve members, otherwise it becomes too unwieldy.

³ Note that the use of the term “Boards of Examiners” in the document is incorrect and has been changed by the ACPSEM Council to Accreditation Panel.

External Assessors

External Assessors may or may not be members of the Accreditation Panel. External Assessors perform the responsibilities outlined under “Assessment Processes”.

External Assessors are directly responsible to the Accreditation Panel for the organisation, assessment and management of the training program for individual registrars. Normally an external assessor will only be responsible for a single registrar.

When a new external assessor is required in any year for the accreditation program, the procedure will be by a method still to be determined.

Each registrar is appointed an External Assessor by the Chairman of the Accreditation Panel. The External Assessor may assist in the development of the registrar’s proposed training program. The External Assessor is available for consultation by phone by either the registrar or the Clinical Supervisor.

The External Assessor’s responsibilities include:

- Meeting with the Clinical Supervisor and the Registrar at least annually to review the registrar’s progress (see Section on “Progress Review”), completing the annual progress report form and forwarding it to the Nuclear Medicine TEAP coordinator.
- Reviewing Portfolios when submitted (see Section on “Portfolios”).
- Assessing the registrar in the Final Assessment with an Examiner from the Accreditation Panel and the Clinical Supervisor.

Clinical Supervisor

An accredited nuclear medicine physicist (or medical physicist approved by the Accreditation Panel) normally working in the same department as the registrar will be assigned as the Clinical Supervisor for the registrar during in-service clinical training.

The Clinical Supervisor’s responsibilities include:

- Meeting regularly with the registrar to discuss progress with adequate documented feedback provided to the registrar such as competencies achieved and competency achievement which has fallen behind. The registrar’s portfolio will be a central part of this regular review.
- Ensuring that the registrar’s clinical training and performance is monitored, documented, assessed and reported to the External Assessor as required at least annually.
- Providing a confidential assessment to the External Assessor on the knowledge and competencies gained in each Portfolio (see Section on “Portfolios”).
- Meeting with the External Assessor and the Registrar at least annually to review the registrar’s progress (see Section on “Progress Review”).

- Assisting the External Assessor and an Examiner from the Accreditation Panel in assessing the registrar (see Section on “Final Assessment”).

Final Assessment Process

The process will be organised as follows:

- Each registrar will be evaluated in the department where they undertook the bulk of their training
- Assessment will be undertaken by an Examiner from the Accreditation Panel in conjunction with the External Assessor. Where possible both these persons will be recruited locally but neither should have direct connection with the department where the registrar has trained.
- Both the Clinical Supervisor and Registrar will be advised who will act as examiners. Either may request without justification that an alternative examiner be utilised.
- The assessment will occupy roughly half a day and include
 - a presentation on the research and development work undertaken
 - a detailed examination of portfolios
 - an oral exam that includes discussion on all aspects of the training, the portfolios and an area of clinical application selected by the registrar

Appendix 3

Assessment of a Trainee / Registrar in Nuclear Medicine Physics⁴

Aim

To determine whether a registrar has satisfactorily completed the training and education program the Accreditation Panel shall assess the level of knowledge and competencies acquired during the program.

Accreditation in Nuclear Medicine Physics

Upon receiving a satisfactory assessment in the training and education program from the Accreditation Panel the registrar will be accredited in nuclear medicine physics.

Assessment Processes

The Accreditation Panel shall assess the registrar's performance on the following:

- Accredited post graduate degree in Medical Physics to at least a MSc level
- Continuous assessment
- Portfolios and Final Report
- Written exams (exempt if an accredited Masters)
- Assessment by the Clinical Supervisor and the External Assessor
- Clinical Supervisor's reports
- External Assessors report

Overall assessment by the Accreditation Panel:

- Reviewing, Portfolios and Final Report
- Reviewing all assessment reports
- Reviewing practical work undertaken (e.g demonstration and presentation)
- Oral examination
- Assessment of research/dissertations/projects outcomes
- Either one peer reviewed publication as first author and 1 peer reviewed publication as co-author or 3 peer reviewed publications as co-author
- Presented his / her own work to at least 2 meetings (at least 1 at a national or international level).

Postgraduate degree in Medical Physics to at least an MSc level

An ACPSEM accredited MSc degree in Medical Physics or a written statement from the university that the registrar has obtained a level equivalent to an MSc degree in Medical Physics while undertaking an ACPSEM accredited higher level degree (eg a PhD).

⁴ A registrar in Nuclear Medicine Physics is any trainee undertaking the training program. This document is closely aligned with the proposed procedures for assessment of radiation oncology medical physicists.

Progress Review

A progress review shall be held between the Clinical Supervisor, the External Assessor and the registrar on completion of the basic training modules. The registrar review shall consider:

- The clinical and academic progress made by the registrar
- Any changes suggested to the proposed training program
- The Portfolios under development
- Details of the research and development work being undertaken or planned
- The annual reports made by the Clinical Supervisor
- Any feedback and/or recommendations between the three parties on the registrar's performance or the training program itself.

A report on the Progress Review and recommendations shall be forwarded to the Accreditation Panel by the External Assessor.

Portfolios

Portfolios shall be developed for each of the following study areas:

- Instrumentation and QC
- Computer processing
- Radiation protection and dosimetry
- Clinical applications

Each Portfolio provides the evidence, which demonstrates the registrar has acquired the required knowledge and competencies in the individual study area. Guidelines on the work to be undertaken in developing portfolios is provided for competencies in each of the four areas at both basic and advanced levels. The basic components should be completed within 1-2 years after completion of Masters; the advanced components should be completed within 1-2 years of completing the basic components.

On completing the basic or advanced components:

- A copy shall be forwarded to the External Assessor
- The Clinical Supervisor shall provide a confidential assessment to the External Assessor on the knowledge and competencies gained in the Portfolio.
- The External Assessor shall review the Portfolio and if necessary have it reviewed by an examiner with specialist knowledge in the study area.
- There shall be a discussion between the registrar, the Clinical Supervisor and the External Assessor on the Portfolio
- The External Assessor shall make a report and a recommendation of the registrar's performance ("pass", "not of required standard") in this portfolio
- When the recommendation is "not of required standard" the registrar may:
 - Request a review by the Accreditation Panel
 - Revise the portfolio and resubmit for assessment

- When the recommendation is “pass”, the report and recommendation is forwarded to the Accreditation Panel along with a copy of the portfolio.

Written Exams

Trainees who have not completed an accredited Masters program will be required to sit a written exam at Masters level on all aspects of medical physics.

Final Report⁵

The registrar shall write a Final Report summarising the evidence which demonstrates the registrar has acquired the required knowledge and competencies and is ready to assume a position of responsibility in the field.

It shall include:

- A Table of Contents
- A brief curriculum vitae
- The registrar’s Training Plan
- The registrar’s job description
- The department structure diagram and the registrar’s place in it
- A brief summary of each portfolio indicating the knowledge and competencies acquired; this is mainly intended to highlight any alternative evidence to that suggested in the training modules.
- A list of courses, meetings, seminars attended and a brief critique of each and its value
- A brief description of research and development projects; outcomes should be highlighted (e.g. publications and presentations).
- A brief description of protocols and procedures the registrar has helped to develop and write and the registrar’s role in the development
- A brief description of internal reports the registrar has helped develop and the registrar’s role in the development
- Published papers
- Sources must be quoted
- Not more than 10,000 words in the main text

The Final Report should be completed only when the advanced modules are complete.

On completing the Final Report:

- The Clinical Supervisor shall provide a confidential assessment to the External Assessor on the overall knowledge and competencies acquired by the registrar and the registrar’s general attitude and performance. Included in the report will be an assessment of the capability of the registrar to work unsupervised and to take responsibility.

⁵ The final report is intended to provide an overview of the work undertaken in the overall training program and is not intended to duplicate or simply summarise results that are presented in the portfolios.

- The External Assessor shall review the Final Report.
- There shall be a discussion between the registrar, the Clinical Supervisor and the External Assessor on the Final Report
- The External Assessor shall make a report and a recommendation of the registrar's performance ("pass", "not of required standard")
- When the recommendation is "not of required standard" the registrar may:
 - Request a review by the Accreditation Panel
 - Revise the report and resubmit for assessment
- When the recommendation is "pass", the report and recommendation is forwarded to the Accreditation Panel.

Final Assessment

The final assessment of the entire program shall consist of:

- A review of the registrar's assessment to date including the yearly progress reviews, theory exams, portfolios and final report.
- A general oral on all aspects of nuclear medicine physics including the portfolios and the final report (1.5 hours). The registrar should also elect one clinical area for detailed discussion.
- A 20 minute presentation by the registrar on a research topic of the registrar's choosing plus 10 minutes for questions (0.5 hours). This should outline the research work undertaken by the registrar during the training period. The registrar should be prepared to demonstrate any developed software or practical components of their research.

The outcome of the final assessment may be:

- A pass
- A fail. In this case the registrar may attempt the final assessment again in a minimum of six months time.

Overall Assessment

The registrar must obtain a satisfactory pass in each of the following elements of the assessment process:

- Accredited Masters degree
- Each Portfolio
- The final report
- The final assessment

On obtaining a satisfactory accreditation assessment a recommendation shall be made to the ACPSEM Council that the registrar has satisfied the requirements of the training program in Nuclear Medicine Physics and should be accredited in Nuclear Medicine Physics.

Assessment Criteria

There are two parts to the assessment criteria. Firstly, to determine that the candidate can satisfactorily complete aspects of nuclear medicine physics work that are commonly encountered in clinical practice. Secondly, to satisfy the Panel that the candidate can work safely without supervision. Being able to assess that an individual can work safely without supervision is more difficult than assessing practical competency. It requires an assessment of the behavioural characteristics that a candidate exhibits in undertaking the oral exam questions and an assessment of the candidates scientific ability, in addition to assessment of their knowledge and skills.

1. Broad understanding of a task or issue
2. Theoretical aspects relating to a task or issue
3. Practical aspects of undertaking a task or issue (including proficiency in completing task)
4. Interpreting the data (including a knowledge of relevant standards or expected results) and its applicability to other aspects such as planning or treatment
5. Demonstrate a clear understanding of the processes involved
6. Demonstrate the ability to clearly & logically explain the work as it is undertaken and by answering questions
7. Satisfy the Accreditation Panel that the candidate would satisfy the following and that the Accreditation Panel would be confident that the candidate could safely work without supervision⁶:-
 - i) Identify & define a problem and formulate strategies for solving it
 - ii) Approach work analytically and thoroughly
 - iii) Critically evaluates processes and outcomes
 - iv) Takes due care with their work.
 - v) Applies quality management strategies to their work
 - vi) Interpret novel or non-standard data
 - vii) Make value judgements in unfamiliar situations
 - viii) Self assured & "thinks well on their feet"
 - ix) Communicate scientific information clearly and accurately to others
 - x) Recognise fault situations and take suitable corrective action
 - xi) Appreciate the limitations of one's knowledge & ability.
 - xii) Take responsibility for own work

Appeals

Providing Council's policy on examination appeals is satisfied, the candidate may appeal against a decision of "not of required standard" made at any time by the External Assessor or by an adverse final result issued by the Accreditation Panel. See the "Appeals Process for ACPSEM Accreditation" document.

⁶ Based in part on the IPEM's definition of a professional physicist.

Appendix 4

Accreditation in Nuclear Medicine Physics: application questionnaire for experienced Nuclear Medicine Physicists

Applicants should attach a detailed CV that highlights evidence to support the applicant's case. The Accreditation Panel will assess the application based on the stated evidence and may request copies of specific evidence for inspection.

Name:

Current position title:

full-time part-time hours/week in NM

Department:

Address:

Telephone:

Fax:

Email:

Briefly describe your current role:

Qualifications (specify University and date):

How many years full-time equivalent work in Nuclear Medicine (give details):

Provide the names, addresses, email, phone and fax numbers for two professional referees who can verify the information provided in this application.

Referee 1:

Referee 2:

Your contact address (if different from above):

a) General Medical Physics Knowledge

Indicate below details of any formal course attended in Medical Physics or relevant topic, together with any qualification obtained. Also indicate in the syllabus below what topics were covered in these courses. Use the following to grade the level of coverage overall.

- 5 extensive coverage
- 4 significant coverage
- 3 moderate coverage
- 2 some coverage
- 1 no coverage

Courses attended Dates Qualification obtained

General Medical Physics Syllabus

- Radiation protection and regulatory requirements
- Radiation oncology physics
- Diagnostic radiology physics
- Nuclear medicine physics
- Anatomy and Physiology
- Management skills
- Communication skills

Electives

- Computers
- Statistics
- Modelling
- Electronics
- Other (specify)_____

b) Nuclear Medicine experience

In each of the following areas of Nuclear Medicine physics please summarise your experience and list available documentation that supports your application (there may be a request to review this information, however, this should not be attached to the application).

Please also indicate how you would rate your past experience in each of the specified areas in the syllabus using the ratings below. Candidates should refer to the Nuclear Medicine Accreditation and Training Syllabus for details of the expected competencies. Tasks include basic / registrar (i) and more advanced / base level tasks (ii). Note that it is not expected that all persons will have had experience in all tasks specified.

5 very significant experience	or	definitely understood
4 significant experience	or	probably understood
3 some experience	or	some understanding
2 little experience	or	possibly not understood
1 no experience	or	definitely not understood

1.1. *Radiation safety & dosimetry*

General Experience:

Documentation⁷:

Basic Level

- a) Demonstrate understanding of ALARA principles
Documentation⁸:

- b) Operate area and staff radiation monitoring equipment
Documentation:

- c) Maintain radiation records
Documentation:

⁷ List here documentation, if any, that demonstrate your experience/expertise this syllabus area, e.g. hospital radiation safety manual, minutes of meetings, lecture notes, radiation safety reports on research projects, etc.

⁸ List here specific items of documentation, if any, that support your expertise/experience on this specific topic, e.g. laboratory survey reports.

- d) Deal with a radiation spill and document the incident
Documentation:
- e) Discuss local operational procedures for therapy using unsealed sources
Documentation:
- f) Carry out a radiation survey of a laboratory
Documentation:
- g) List typical doses encountered by patients undergoing nuclear medicine procedures
Documentation:

Advanced level

- a) Demonstrate an understanding of the relevant regulations pertaining to the use of ionising radiation
Documentation:
- b) Develop radiation safety guidelines associated with a clinical procedure
Documentation:
- c) Design an area for the use of unsealed radioactive materials
Documentation:
- d) Calculate the patient dose for a new procedure
Documentation:
- e) Provide advice to staff and patients regarding radiation risk
Documentation:
- f) Introduce procedures that reduce the radiation exposure of staff and /or members of the public
Documentation:

- g) Prepare a radiation safety report of the Institutions Ethics Committee for a research protocol involving nuclear medicine procedures
Documentation:

1.2. Quality assurance and acceptance testing

General Experience:

Documentation:

Basic level

- a) Perform basic gamma camera and SPECT QC procedures
Documentation:
- b) List procedures for gamma camera calibration (e.g. uniformity, energy corrections)
Documentation:
- c) Undertake first line trouble shooting for a camera / computer system
Documentation:
- d) Investigate parameters influencing instrument performance
Documentation:
- e) Operate and perform QC for Dose Calibrator
Documentation:
- f) Check operation of display and hardcopy devices

Documentation:

Advanced level

- a) Demonstrate an understanding of the physical principles involved in the design of imaging instrumentation, the medical imaging process and potential sources of error
Documentation:

- b) Compare equipment performance as a basis for system purchase
Documentation:

- c) Perform acceptance tests for a gamma camera with SPECT and whole body scanning capability
Documentation:

- d) Supervise a routine QC program and document results
Documentation:

- e) Demonstrate use of phantoms for quantitative evaluation of system performance
Documentation:

1.3. Computer programming and management

General Experience:

Documentation:

Basic level

- a) Demonstrate understanding of the general techniques applied in

- computer processing of medical images and the underlying physical principles
Documentation:
- b) Demonstrate familiarity with the operation of a clinical workstation
Documentation:
 - c) Perform basic computer system administration tasks
Documentation:
 - d) Perform analysis of clinical studies and advise on sources of error
Documentation:
 - e) Perform first line trouble shooting
Documentation:
 - f) Develop programs for image analysis in a high level language
Documentation:
 - g) Demonstrate ability to devise a working algorithm for a simple task in flowchart language
Documentation:

Advanced level

- a) Demonstrate understanding of principles involved in processing of medical images
Documentation:
- b) Develop clinical application software in a high level language
Documentation:
- c) List details of standard image formats used in nuclear medicine
Documentation:

- d) Validate software using simulation, phantoms and clinical data
Documentation:
- e) Implement and document aspects of system management
Documentation:
- f) Demonstrate understanding of advanced networking principles
Documentation:

1.4. Clinical applications

General Experience:

Documentation:

Basic level

- a) List protocols for routine clinical procedures
Documentation:
- b) Recognise common artifacts in clinical images
Documentation:
- c) Perform analysis for common clinical studies and describe sources
of error
Documentation:
- d) Participate in a clinical research project
Documentation:

Advanced level

- a) Demonstrate understanding of principles and physiological basis for common clinical procedures
Documentation:

- b) Develop a clinical protocol for estimation of patient dosimetry
Documentation:

- c) Investigate sources of artifact or quantitative error
Documentation:

- d) Undertake a clinical research or validation project (preferably as primary investigator)
Documentation:

1.5. Research and development

Publications and presentations (include list in CV)

- List number of first author papers in peer reviewed journals
- List number of peer reviewed journal papers where you are a co-author
- List number of other published papers
- List number of presentations as first author at local meetings
- List number of presentations as first author at international meetings
- List any additional evidence of research and development experience

1.6. Teaching

Number of Medical Physics cadets / trainees supervised

Number of undergraduate students supervised

Number of Masters students supervised

Number of PhD students supervised

List medical physics subjects taught with details of students
Dates Subject Type of student / award Class size

List other teaching experience (e.g. course management), academic appointments

1.7. Management

Current title

Specific management training

Number of staff currently under direct supervision

Hospital / department committees

Duties on professional committees

Involvement with international organisations / meetings

Project management examples

1.8. Application of medical physics

In which one of the following subject areas do you wish to be assessed?

Cardiology

Neurology

Oncology

Renal and GIT studies

Endocrinology

Please list any documentation relevant to your assessment in this area (e.g. any relevant publications, presentations, reports, committees):