ARASIA Residency for Medical Physicists in Radiation Oncology

FOREWORD

The application of radiation in human health, for both diagnosis and treatment of disease, is an important component of the work of the International Atomic Energy Agency (IAEA). The responsibility for the increasing technical aspects of this work is undertaken by the medical physicist. To ensure good practice in this vital area structured clinical training programmes are required to complement academic learning. This publication is intended to be a guide to the practical implementation of such a programme for radiation therapy.

There is a general and growing awareness that radiation medicine is increasingly dependent on well trained medical physicists that are based in the clinical setting. However an analysis of the availability of medical physicists indicates a large shortfall of qualified and capable professionals. This is particularly evident in developing countries. While strategies to increase academic educational opportunities are critical to such countries, the need for guidance on structured clinical training for Arab-Asia (ARASIA). Member States was reiterated by the members of ARASIA TC RAS6054 project. Consequently a Working Group was appointed during the Amman Coordination Meeting on June 7-11, 2009, to address this need in the ARASIA region. The current document draws heavily on the comprehensive IAEA Training Series No. 37 [1] which is based on the work developed under the RCA project, RAS6038.

The ARASIA residency training document is to be applicable to all the ARASIA Member States. Furthermore, the residency training program shall be nationally piloted at selected centres in ARASIA Member States. However, it is proposed to be regionally piloted at the King Faisal Specialist Hospital & Research Centre in Riyadh, Saudi Arabia, for a period of several years.

The IAEA acknowledges: the special contribution of the Working Group chaired by Belal Moftah (Saudi Arabia), and its members: Shada Wadi-Ramahi (Jordan), Wassim Jalbout (Lebanon), Hanna El Balaa (Lebanon), Abdulkader Sadiyyah (Syria), Jamila Al-Suwaidi (United Arab Emirates), Abdo Al-Qubati (Yemen) and Rabeea Al-Daffaie (Iraq). The IAEA officers who helped with this publication were Donald McLean of the Division of Human Health and Mahfoudh Serhan Abdullah of the Division of Asia and the Pacific, IAEADepartment of Technical Cooperation. Two IAEA experts (Shan Yau and Guenther Hartmann) advised the Working Group during its work at various stages.

CONTENTS

1. INTRODUCTION

1.1. The need for physicists in radiation oncology

Medical physicists fulfil an essential role in modern medicine, most commonly in the fields of diagnosis of medical conditions and in the treatment of cancer. Medical physicists working in the field of radiation oncology are generally called "Qualified Medical Physicists in Radiotherapy" or "Radiation Oncology Medical Physicists" dependent upon the country in which they work. They are part of an interdisciplinary team in the radiation oncology department dedicated to providing safe and effective treatment of cancer. Other members of the team include oncologists, therapists, maintenance engineers and nurses.

Medical physicists make a major contribution to the safe and effective treatment of patients with cancer. Their knowledge of physics, particularly radiation physics and how radiation interacts with human tissue and of the complex technology involved in modern treatment of cancer are essential to the successful application of radiation therapy [2]. The radiation oncology medical physicist's responsibilities cover five major areas: dosimetry, treatment planning, quality control, equipment selection and radiation safety. A large part of the duties involves commissioning, calibration, and quality assurance (QA) of the ever increasingly complex equipment used in the radiation oncology department.

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources [3] states that "for therapeutic uses of radiation (including teletherapy and brachytherapy), the calibration, dosimetry and quality assurance be conducted by or under the supervision of a qualified expert in radiotherapy physics".

It has been well documented that accidents can occur in the practice of radiation oncology when proper QA is not performed [4-6]. Appropriate QA can only be implemented and practiced by adequately trained staff.

1.2. The need for structured and supervised clinical training of Medical Physicists specialising in Radiation Oncology

The IAEA [7] states that a clinically qualified radiotherapy[1] medical physicist must have

- A university degree in physics, engineering or equivalent physical science
- Appropriate academic qualifications in medical physics (or equivalent) at the postgraduate level,
- At least two years (full time equivalent) structured clinical in-service training undertaken in a hospital.

The IAEA also states that "It is emphasized that the holder of a university degree in medical physics without the required hospital training cannot be considered clinically qualified."

This education and training should be recognised by a regional/national accreditation body. The lack of recognition of medical physics standards is a problem common to almost all countries. However a national accreditation process, ideally through a professional organisation, is seen as vital in raising the standard of the practice of medical physics. The

[1] Also known as radiation oncology medical physicist.

continuing professional development of the practicing medical physicist through short courses, conference attendance, access to the scientific literature etc should then follow.

Postgraduate courses in medical physics at the Master level are offered by many universities. To enrol in these courses, students are normally required to have completed an undergraduate (bachelor level) degree in physics or a suitable alternative. These Master courses are typically of 18 - 24 months duration and provide the graduate with knowledge of the physics and technology underpinning the practice of radiation oncology, however in order to independently and safely perform the roles and responsibilities of a medical physicist a significant period of structured in-service clinical training is required. The duration of this clinical training is agreed to be at least 24 months full time and can only be provided in a hospital with access to full radiation oncology services under the supervision of a qualified medical physicist. Hence the total time required for education and clinical training of a medical physicist is at least 4 years (2 years university education at the graduate level plus at least 2 years in-service clinical training) following completion of a bachelor degree in physics or acceptable alternative. Clinical experience during any graduate program is NOT counted towards the 2-year residency training.

1.3. Why this programme?

The shortage of clinically qualified medical physicists is a worldwide problem that is well recognised and is most acute in developing nations. The need for medical physicists is becoming more evident due to the increasing complexity of both treatment and diagnostic equipment coupled to the raising expectations of good health care in all parts of the world as well as the implementation of radiation protection and safety standards, however the supply of suitably qualified and trained personnel has not kept up with these developments and hence this shortage is worsening.

While there are an increasing number of Master level courses in medical physics offered by universities in many countries of the world, the clinical in-service training component for the total process has, in many cases, been missing. This has resulted in incomplete preparation of the medical physicist to practice independently as important aspects of training cannot be completed in the university setting. A structured in-service clinical training programme provides a better preparation for medical physicists to ensure that they are capable of independent, safe and effective practice. Such a programme should reduce the total time needed for medical physicists to reach clinical competence and also prepare them to undertake more advanced methodologies which are being rapidly introduced in radiotherapy. Relatively few countries have developed national standards of clinical training, which is an essential part of ensuring high quality and consistent training throughout a country.

The IAEA has a long history of involvement in medical physics education and training and has recently developed a guide and other material to be used in the clinical training of the next generation of Medical Physicists specialising in Radiation Oncology.

Persons undergoing training in this programme are referred to as Residents (also known by other names including interns). A Resident medical physicist is expected to be an employee of a hospital or clinical centre with suitable radiation oncology services and would contribute to the routine duties of medical physicists within that department under the supervision of senior medical physicist specialising in radiation oncology. This contribution would initially be more in the role of an assistant but would, as the Resident's level of knowledge and skills

progressed, become more and more substantial. In the final 6-12 months of training the Resident would make an independent contribution to many of the roles of the medical physicist, requiring only limited supervision. Hence the investment of time and effort in training Residents is repaid as they become more senior and increase their contribution back to the radiotherapy services.

2. OBJECTIVE OF THE CLINICAL TRAINING PROGRAMME

The objective of the clinical training programme for Medical Physicists specialising in Radiation Oncology is to produce an independent practitioner who is a life long learner and who can work unsupervised at a safe and highly professional standard.

The CLINICAL TRAINING programme is seeking to assist this objective through

- Provision of this detailed guide to clinical training and appendices I - III
- Provision of an implementation strategy to allow effective clinical training. Forming a basis for a national or regional qualification (education and clinical training) standard.
- Providing assistance to national bodies and departments to deliver the training programme through a pilot programme
- Promoting quality improvement of the programme, and
- Strengthening of the national capacity to sustain such a clinical training programme after initial introduction.

3. ESSENTIAL REQUIREMENTS FOR IMPLEMENTATION OF THE CLINICAL TRAINING PROGRAMME.

Please see Chapter 7 for more detail on this section

3.1. Programme management

3.1.1. National

The programme should be managed under the direction of a national authority such as the Ministry of Education, Ministry of Health, relevant professional body or the National Atomic Energy Authority. It will have overall responsibility for management of the programme and is referred to, in this publication, as the **National Responsible Authority**.

The National Responsible Authority provides **formal recognition** of the qualification "Radiation Oncology Medical Physicist" (or equivalent) and the requirements to become one.

In managing the programme the National Responsible Authority must:

- Establish a ***National Steering Committee*** to oversee the programme. The National Steering Committee is the working arm of the National Responsible Authority. The Committee comprises of representatives from the relevant professional body (where one exists) and other relevant interest groups and stakeholders (such as ministry of health, universities, radiation protection authority, allied professional societies etc.). It is highly recommended that representatives from the relevant professional body should form the majority of members. It is expected that the National Steering Committee will delegate its day to day responsibilities to the National Programme Coordinator.
- Appoint a ***National Programme Coordinator*** to oversee the implementation of the programme (appointment of several Programme Coordinators may be justified in large countries where regional coordination is necessary). The National Programme Coordinator should, ideally, be a person engaged in the practice of radiation oncology medical physics. The Coordinator will normally report to the National Steering Committee.
- Ensure that the ***Professional Body*** sets the professional standards required to define competency, provides professional support for the programme and has overall responsibility for the assessment processes.

- Establish a ***Support Group*** of individuals who agree to assist with Resident training. The support group may include radiation oncologists, radiation oncology medical physicists and personnel from educational institutions. Preferably one person external to the country should be a member of the support group.

3.1.2. External

The program shall be nationally piloted at selected centres in ARASIA Member States. However, it is proposed to be regionally piloted at the King Faisal Specialist Hospital & Research Centre (KFSH&RC) in Riyadh, Saudi Arabia, for a number of years. For these pilot programmes an external management structure has been formed to coordinate external support and to oversee the general conduct of the programme. A coordinator will be appointed to work closely with the National Programme Coordinator and National Steering Committee to ensure the smooth operation and success of the programme. External experts may also be utilised to assist departments with aspects of the programme and to monitor standards of assessment.

3.2. Minimum requirements for departments where residents are located

For a department to participate in the programme it must:

- Provide a Resident with a supervisor who is experienced and clinically competent in radiation oncology medical physics[2].

[2] Normally, the number of residents in a department should not exceed the number of clinically competent medical physicists in that department; however this may vary according to local situations including department workload.

- Have (on-site) a specified range of radiation oncology, dosimetry and imaging equipment with appropriate established QA processes. If certain equipment is not present, preparedness to rotate Residents to other departments (where that equipment is available) is acceptable
- Offer a full-range of radiation oncology services and employ medical practitioners trained in radiation oncology.
- Provide Resident's with access to textbooks and other relevant resources such as the internet.

Adequate clinical training resources including experienced medical physicists specialising in radiation oncology are essential for the successful implementation of the programme.

4. ELEMENTS OF THE CLINICAL TRAINING PROGRAMME

Documents to assist countries in implementing a structured clinical training programme for Radiation Oncology Medical Physicists have been developed. These are included as seen below:

- Chapter 5: A Resident's guide for the programme
- Chapter 6: A Clinical Supervisor's guide to the fulfilment of their important role in this programme
- Chapter 7: An implementation manual to assist a country and departments with the introduction of the programme
- Appendix I: A guide which is divided into modules and sub-modules relating to the essential elements of the roles and responsibilities of medical physicists specialising in radiation oncology. Each sub-module contains suggested items of training to assist the Resident in acquiring necessary knowledge and skills in the area.
- Appendix II: A guide to the assessment of competency in the areas of these sub-modules and other aspects of the programme.
- Appendix III: Supplementary forms and documents

5. RESIDENT'S GUIDE

5.1. INTRODUCTION

This Chapter has been developed to assist Residents with their understanding of the nature of the programme as well as the roles and responsibilities that they and others have in ensuring optimum clinical training.

It is important that this Chapter is carefully read before commencing clinical training.

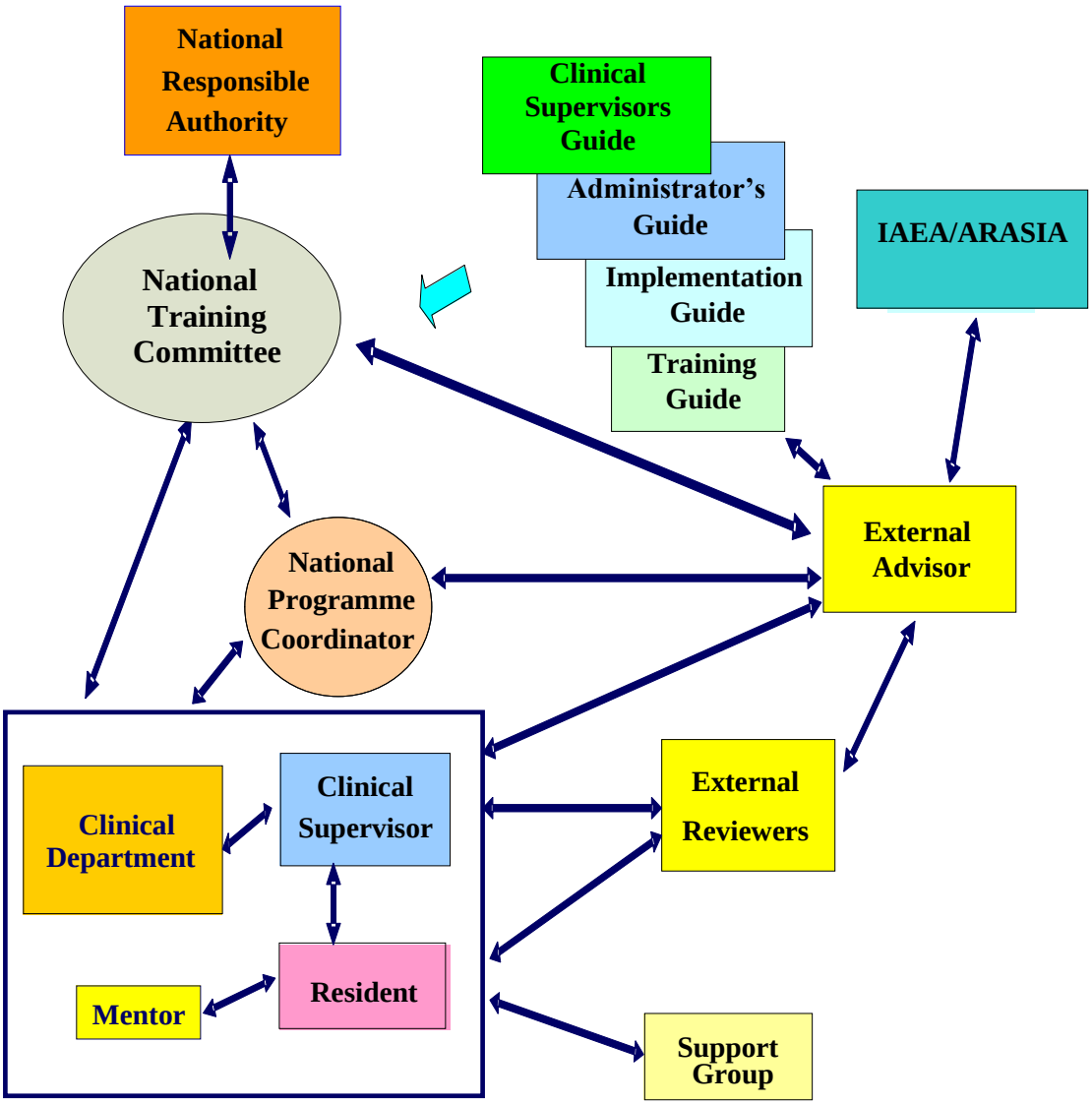

FIG. 5.1. Schematic showing the management structure and lines of communication within the IAEA/ARASIA pilot clinical training programme. Some lines of communication (e.g. department-resident) have been omitted for simplicity.

5.2. STRUCTURE OF THE CLINICAL TRAINING PROGRAMME

The structure and lines of communication within the IAEA/ARASIA pilot of the clinical training programme are shown schematically in Fig. 5.1. Following is a brief explanation of the roles of the some of the groups/persons indicated in Fig. 5.1. Further details can be found in Chapter 7 *Implementation guide*.

- The ***National Responsible Authority*** such as the relevant professional body, Ministry of Education, Ministry of Health or the National Atomic Energy Authority, has overall responsibility for the programme. It provides formal recognition of the qualification provided by the program. It will form a National Steering Committee and appoint a National Programme Coordinator. The National Responsible Authority will normally delegate authority to a National Steering Committee to oversee the program.

- The ***National Steering Committee*** is comprised of the Professional Body and representatives from relevant interest groups and stakeholders. The National Steering Committee is responsible for maintaining standards in the programme by ensuring that guidelines for participation are strictly followed by Departments and Residents. It deals with complaints and appeals. It supervises the National Programme Coordinator.

- The ***Professional Body*** is responsible for setting the professional standards required to define competency and providing professional support for the programme. It would normally have overall responsibility for the assessment processes.

- The ***National Programme Coordinator*** is responsible for coordination of the project and liaises with Residents and their Clinical Supervisors to ensure that the quality of training is appropriate and that Residents develop adequate skills and professional attitudes.

- The ***Clinical Supervisor*** is a suitably qualified and experienced medical physicist specialising in radiation oncology who is working in the same department as the resident. He or she has a pivotal role in ensuring the success of the clinical training of a resident. See section 5.4 for more details on the roles and responsibilities of the Clinical Supervisor.

- The ***Mentor*** may be the Clinical Supervisor, another person or a support group . It is important that the "mentor" is someone that the resident chooses to perform this role. The Mentor may provide advice on professional and personal issues and particularly can help in establishing a work – life balance. For more involved personal issues however the resident should be referred to the hospital counsellor or other suitable professionals.

- The ***Support Group*** is made up of individuals who agree to assist with Resident training. The support group may include radiation oncologists, radiation oncology medical physicists and personnel from educational institutions. Ideally, at least one person, external to the country, is also a member of the support group.

- The ***External Reviewers*** monitor the progress of individual Residents and review their work plan or items of assessment.

5.3. ROLES AND RESPONSIBILITIES OF RESIDENTS

Success of the clinical training programme relies on you, the Resident, undertaking self-directed study including, in consultation with the Clinical Supervisor, determining deadlines. You must also take individual responsibility for meeting those deadlines. Difficulty completing the programme is expected to be encountered when a Resident has low initiative and/or is slow to accept responsibility.

Termination of the clinical training position may be considered if you fail to meet the standards required in the programme following a period of supportive and corrective feedback and opportunity to improve.
Your responsibilities include:

- Meeting regularly with your Clinical Supervisor to discuss progress and to review deadlines.
- Accepting the supportive and corrective feedback provided by your Clinical Supervisor and other experienced medical physicists in your department. You need to accept this feedback in the spirit that it is provided, i.e. to assist in improving your performance in the programme.
- Maintaining necessary documentation. An important example is to ensure that your Clinical Supervisor "signs off" after completing a competency assessment.
- Preparing in a thorough manner for all assessments required as part of the programme.
- Taking every opportunity to develop your knowledge and skills and, once acquired, maintaining the knowledge and skills.

5.4. ROLES AND RESPONSIBILITIES OF CLINICAL SUPERVISORS

The clinical supervisor's responsibilities include:

- Ensuring that the Resident is trained in all significant aspects of radiation oncology medical physics by facilitating a structured training programme in keeping with the guide and with the scope of modules and assessment levels to be completed as determined by the National Steering Committee. Note that this does not mean that all the training is done by the supervisor. It is the responsibility of the supervisor to ensure that suitably qualified specialists undertake the training of the Resident in the various facets of the programme.
- Meeting regularly with the Resident to discuss progress (including reviewing deadlines) and to provide adequate supportive and corrective feedback to the Resident such as the level of competency achieved and competency achievements which have fallen behind.
- Providing a six monthly report on the Resident's progress to the National Programme Coordinator.
- Ensuring that the Resident's clinical training and performance is monitored, documented, assessed and reported as required.
- Ensuring that the in-service clinical training is provided to a standard acceptable to the National Steering Committee and providing to the Resident support where required.
- Ensuring that the Resident is placed in other hospitals, where possible, for short periods to gain experience in techniques or the use of equipment not available in the Resident's own department.

- Ensuring that the Resident has sufficient opportunity to prepare for all assessments required as part of the programme.

- Facilitating external assessments of Residents during their training where possible.

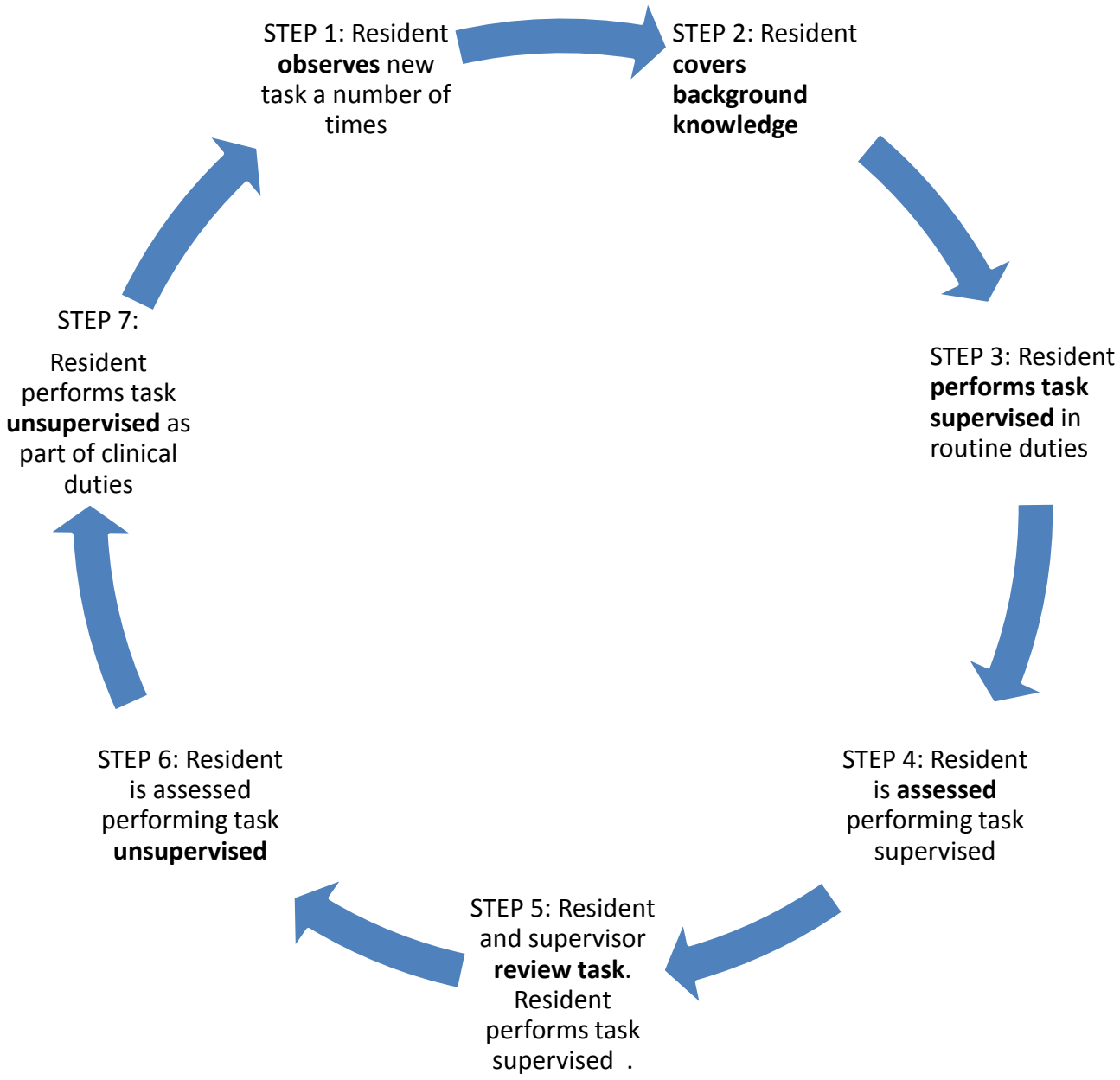

FIG. 5.2: Timeline of clinical training and competency assessment. Step 4 to Step 5 may occur after the Resident has had some experience.

5.5. IMPORTANT APPENDICES

In addition to the current Chapter there are several other parts of this publication which are of importance to you as a Resident in the programme. These are:

- *The Clinical Training Guide (Appendix I)*
- *Competency Assessment (Appendix II)*
- *The Supplementary Forms and Documents (Appendix III).*

You should keep a hard copy of each of these appendices. You will need to refer to the Clinical Training Guide frequently during your residency and the Competency Assessment appendix will need to be updated as competencies are tested by your Clinical Supervisor or nominee. It may also be inspected by the National Programme Coordinator, the external coordinator or external advisor.

5.6. RESIDENT RECRUITMENT

Residents can only be recruited by departments which have been approved by the National Steering Committee for clinical training of Residents in this programme. The prospective Resident must submit a completed "Application for Entry" form to the National Programme Coordinator (see Appendix III) and only becomes a Resident when this application has been approved by the Regional Steering Committee and/or the External Expert in the case of the IAEA pilot regional programme.

As a prospective Resident you should have a clear understanding of the expectations and duration of the clinical training programme.

5.7. NEW RESIDENT ORIENTATION

In addition to the regular hospital and departmental orientation, a new Resident will be given an orientation to the Clinical Training programme in their country.

The first meeting between yourself as a new Resident and your Clinical Supervisor will cover the following aspects

- Explanation of the Clinical Supervisor's role
- Expectations for the Clinical Training Programme
- Responsibilities of the Resident in the Clinical Training Programme,
- The evaluation and assessment schedule (including a regular time for at least monthly meetings).
- Notification of the timing of external assessment including annual reviews
- Direction to resources (e.g. sample assignments, access to basic text books, etc)
- Availability of scholarships and other funding to attend courses and conferences
- Requirement to attend seminars, clinical meetings and level of participation expected
- Role of National Programme Coordinator and other relevant persons outside the department
- General employee duties and responsibilities
- Questions from the Resident

In this meeting you should also discuss with your Clinical Supervisor the following training materials:

- Draft learning agreement including training schedule for the first six months and every 6 months onward.
- Resources for appropriate documentation requirements

5.8. RESIDENT AGREEMENT WITH SUPERVISOR

Within the first two months a new Resident and his/her Clinical Supervisor should finalise a learning agreement, including learning needs, schedule of training, objectives, resources and strategies. Learning agreements should include a schedule for achievement of specific competencies in the next 6 months as well as an overview of the schedule for completion of the entire training programme (see section 5.9 for an explanation of competency as used in this programme).

You need to be aware that the schedule may need to be changed.

Requirements including the scope of competencies and the assessment criteria should be discussed.

The advantages of a learning agreement include:

- Identifying learning needs and resources,
- Providing a forum for discussion of the feasibility of goals relative to the timing and size of workload for the department, Supervisor and Resident,
- Encouraging communication between the Resident and Supervisor,
- Giving you, the Resident, a sense of ownership and commitment to the plan and it is clearly conveyed that you need to take responsibility for your own learning,
- Creating and implementing a strategy which is important due to the volume and scope of work to be completed in the training programme, and
- Prompting evaluation.

Disadvantages include the need for regular updating of the plan as timing of a significant portion of clinical training may be difficult to predict.

As soon as practical, a plan for successful completion of the clinical training programme on schedule should be developed, identifying

- Short, medium and long term learning outcomes
- Timing of final (national) assessments to permit prioritization of competency completion
- Timing of research and clinical requirements, including courses and conferences
- Timing of clinical rotations, such as Imaging and other Radiation Oncology Treatment Centres.
- Level of independence required.
- A contingency plan for spare time e.g. assignments or knowledge-based competencies.
- Potential issues or situations that may impact on the training experience, such as major changes within the department.

- Opportunities for practice-based learning. For example, attending machine break-downs to observe trouble shooting,

A sample template to assist with the preparation of a learning agreement is provided in the appendix "Supplementary Forms and Documents".

However, the Supervisor and Resident may choose a document that suits their style and is not too time intensive (relative to their needs). An alternate method can be chosen as long as it conveys all the required information and prompts the allocation of resources and staff to support the clinical training.

The learning agreement must be mutually agreed upon as it has to be feasible for both parties and acknowledge the responsibility of both Resident and Supervisor to meeting deadlines. It should take into account departmental and supervisor requirements. Advantages of a learning agreement include:

- Ensuring that the assessment of a significant number of competencies are not left to very late in your programme
- Planning items of training which require access to equipment or cooperation of other staff.

You will need to have or develop good time management skills in order to fulfil your responsibilities of the learning agreement.

Form 2: ANNUAL CHECKLIST FOR RESIDENTS and Form 3: COMPLETION CHECKLIST FOR RESIDENTS are two further checklists to prompt discussion and completion of requirements.

Note that a Supervisor cannot be held responsible for not completing competency assessment before a deadline if you do not meet milestones or submit a significant amount of work for assessment at the last minute.

It is expected that you may initially need careful guidance to ensure that you achieve milestones and levels of competency as per your learning agreement. However as you progress through the programme, you must become more active and self-directed and accept a greater level of responsibility. It is part of the role of a Clinical Supervisor to guide the Resident through this professional development. One approach to clinical training and competency assessment is shown schematically in Fig. 5.2.

5.9. ASSESSMENT

There are several components to the assessment of a Resident in the Clinical Training Programme

- **Competencies** (as per the sub-modules of the Clinical Training Guide)
  Each sub-module defines a unified portion of clinical knowledge or skills. All competencies (or sub-modules) required are listed in the Clinical Training Guide. The

sub-modules to be undertaken and the level of competency required to be achieved in each sub-module have been determined by the Responsible National Authority, or its delegate, and are indicated in the Clinical Training Guide.

The Clinical Supervisor can schedule competency assessment at any agreed time. The sub-modules can be undertaken in any order and more than one module can be undertaken at a time. The assessment should comply with the learning agreement and focus on one or a number of the following factors:

- **Clinical work**, i.e. qualified staff formally observes routine clinical tasks as ongoing assessment of competence,
- **Module-focussed**, i.e. clinical work is assigned and responsibility given once the competencies within a particular module are covered, e.g. responsibility for checking treatment plans can be given once all related planning competencies are completed.
- **Commissioning-focussed**, i.e. scheduling of competencies is related to departmental commissioning projects. This is opportunistic learning and may incorporate several areas of competencies.

It is expected that many competencies will be assessed on several occasions. For example: a particular competency might be worked on for some time and the Resident assessed as having obtained a level of 3. The Resident might then be rotated to another area and return to work on the first competency (sub-module) at a later time with a second assessment being conducted at the end of this period. Following any assessment of competency the Resident will be provided with supportive and corrective feedback. You should not be upset by this feedback. Note that the assessor will indicate how you can improve your performance in the programme.

The competency assessment criteria are provided in the Clinical Training Guide. As demonstrated by the criteria, competency assessment is not just reviewing technical ability but also attitudes, such as safe practice and communication skills, expected of a qualified medical physicist specialising in radiation oncology.

- **Assignments**

Three assignments must be submitted during the training programme. These should be submitted no later than approximately 9, 15 & 21 months after commencement of the training programme. (This schedule for submission may be altered by the National Steering Committee) These assignments will be marked by an appointee of the National Steering Committee and possibly by an external reviewer nominated by the external coordinator and be returned, within one month of submission, to the Resident so as to provide feedback. You should discuss the feedback received with your Clinical Supervisor.

The assignments will be graded on a 5 to 1 scale with grades of 4 and 5 being unsatisfactory, 3 just satisfactory, 2 good and 1 excellent.

When a grade of 4 or 5 is awarded you will be required to modify the assignment, taking into consideration the feedback provided, and to resubmit the assignment within 1 month for further assessment.

- **Written and Oral Exams**
  These are administered by the National Steering Committee at the end of the training programme. Before taking these exams a Resident must satisfactorily complete ALL other aspects of assessment. The content of the exams will be drawn from the Clinical Training Guide.

- **Practical Exam**
  The practical examination is based on scenarios that a medical physicist may encounter at a senior level and incorporates a range of competencies covering the Clinical Training Programme.

- **A Logbook** is obligatory and is included in the assessment process. The logbook should be maintained by the Resident and contain a record of training experiences with comments as to difficulties experienced and positive learning outcomes. The logbook can also be utilised by the Supervisor to demonstrate that sufficient work has been covered to sign off a competency if it is difficult for the Supervisor to perform practical assessment of that competency. The logbook can be in hard copy or electronic form.

NOTES:

- The Resident must be assessed as satisfactory in each of the above components to be successful in the total programme.
- The required level of competency in ALL sub-modules must be achieved before the oral and written exams can be attempted.
- The oral and written examinations, and practical examination if required, are designed to assess whether the candidate has the appropriate approach of a qualified medical physicist i.e. to work unsupervised in a professional, scientific and safe manner. However as limited technical knowledge and competency can be assessed in these examinations, for the assessment of the majority of the medical physicist's roles and responsibilities it is the assessment of competency in actual practice which has a pivotal role in ensuring safe, competent practice.

5.10. EXAMPLES OF COMPETENCY ASSESSMENT TOOLS WHICH YOU MIGHT EXPERIENCE

There are many possible methods by which your competency in a particular sub-module may be assessed. The assessor may

- observe, listen and question you during routine clinical experience
- listen to you teaching someone else
- provide you with mock scenarios. Examples:
  - communication with patient or colleague (perhaps also a patient based dilemma)
  - request that you write a commissioning schedule for a new linear accelerator
  - commissioning an orthovoltage therapy unit
  - commissioning a HDR afterloader
- suggest that you attend
  - an internal course on conflict management
  - attend a university course for postgraduate students on oral presentation.

- ask a patient or another professional's feedback of how you communicated with them.
- use oral assessment in a regular Supervisor-Resident meeting Short written report with assessment and constructive feedback
- use practical assessment including oral questioning whilst you perform a routine task (e.g. quality assurance, absolute calibration)
- use objective, structured clinical examinations or series of defined clinical tasks.
- review your logbook.
- set clinical project work
- set patient or equipment trouble-shooting case studies
- ask that you list key steps involved in completing a task
- require an external competency test at another department
- request that you participate in a local tutorial programme
- use self-reflection. Do not be surprised if your supervisor asks "how do you think you went?" after completing a competency assessment.
- suggest that you make a presentation to departmental staff
- require that you write
    - sample letters that are assessed by the supervisor on key points.
    - a report on the role of other professional groups.
    - a report on the pathway of a patient from diagnosis to treatment.
- suggest that you compile decision-making diagrams.
- suggest that you critically appraise a journal article in a departmental "Journal Review Meeting".

5.11. CLINICAL ROTATIONS

The Resident may be required to obtain training in other hospitals for periods of time to gain experience in techniques or on equipment not available in the Resident's own hospital. The clinical training guide also requires the Resident to gain knowledge and competencies in Radiology and Nuclear Medicine.

Form 1: CHECKLIST FOR NEW RESIDENTS (0-3 MONTHS OF TRAINING PROGRAMME)

RESIDENT: _____

DATE OF COMMENCEMENT OF RESIDENCY: _____

	date achieved
ALLOCATION OF A CLINICAL SUPERVISOR	
RESIDENT'S APPLICATION FORM SENT TO NATIONAL PROGRAMME COORDINATOR	
LETTER OF ACCEPTANCE INTO TRAINING PROGRAMME RECEIVED FROM NATIONAL PROGRAMME COORDINATOR	
ORIENTATION BY CLINICAL SUPERVISOR	
RESIDENT STARTS A LOGBOOK	
CLINICAL TRAINING GUIDE PROVIDED TO RESIDENT	
SCHEDULE FOR REGULAR SUPERVISOR-RESIDENT MEETINGS ESTABLISHED (at least monthly)	
INITIAL 6 MONTH TRAINING PLAN AGREED	
TRAINING PLAN FOR PERIOD OF ENROLLMENT DEVELOPED AND AGREED WITH CLINICAL SUPERVISOR	
RESIDENT BEGINS ATTENDANCE AT CLINICAL MEETINGS AND/OR TUTORIALS	

Form 2: ANNUAL CHECKLIST FOR RESIDENTS (3 months to completion)

RESIDENT: _____

YEAR: **20____**

	✓ When Satisfactory	Comment
REGULAR SUPERVISOR-RESIDENT MEETINGS HELD (at least monthly)		
RESIDENT LOGBOOK UP TO DATE		
COMPETENCY ASSESSMENT UP TO DATE		
SIX MONTHLY SUPERVISOR REPORTS COMPLETED (AND FORWARDED TO NATIONAL PROGRAMME COORDINATOR		
ANNUAL REVIEW & REPORT ON FILE		
ANNUAL TRAINING PLAN UP TO DATE		
TRAINING PLAN FOR PERIOD OF ENROLLMENT UP TO DATE		
RESIDENT REGULARLY ATTENDING CLINICAL MEETINGS AND/OR TUTORIALS		
ASSIGNMENT FOR THIS YEAR COMPLETED		

Form 3: COMPLETION CHECKLIST FOR RESIDENTS

RESIDENT: _____

SUPERVISOR: _____

COMPLETION OF REQUIREMENTS CHECKLIST	**Date Achieved**
REQUIRED LEVEL OF COMPETENCY ATTAINED IN ALL SUB-MODULES	
LOGBOOK COMPLETED AND ASSESSED AS SATISFACTORY	
THREE ASSIGNMENTS COMPLETED AND GRADED AS 3 OR BETTER.	
WRITTEN EXAM CONDUCTED AND ASSESSED AS SATISFACTORY	
ORAL EXAM CONDUCTED AND ASSESSED AS SATISFACTORY	
PRACTICAL EXAM CONDUCTED AND ASSESSED AS SATISFACTORY (IF REQUIRED)	

6. CLINICAL SUPERVISOR'S GUIDE

6.1. INTRODUCTION

A necessary component of the training of Residents is the guidance provided by a Clinical Supervisor. This handbook is designed to assist Clinical Supervisors in understanding the roles and responsibilities of the position.

The investment of time and effort in training Residents is repaid as they become more experienced and increase their contribution back to the department eventually to senior levels.

6.2. STRUCTURE OF THE CLINICAL TRAINING PROGRAMME

The structure and lines of communication within the ARASIA pilot of the clinical training programme are covered in Chapter 5 and Fig. 5.1. Further details can be found in Chapter 7: *Implementation Guide*.

6.3. APPOINTMENT OF A CLINICAL SUPERVISOR

A suitably qualified and experienced Clinical Supervisor should be appointed by a department seeking to participate in the pilot of the ARASIA clinical training programme. It is important that the Clinical Supervisor has the confidence and willingness to undertake the roles and responsibilities of the position.

The steps in the appointment of a Clinical Supervisor are

- The Chief Physicist, normally, initiates the nomination and makes the proposed Clinical Supervisor aware of the expectations of the position and the impact the supervisory role may have on his/her other duties.
- The proposed Clinical Supervisor should agree to the nomination which needs to be approved by the Head of the Department and the National Programme Coordinator.
- An agreement between the Clinical Supervisor and Chief Physicist is made to ensure effective supervision takes place. If possible, an adjustment of the supervisor's other workload is made to account for the time necessary for administration, training, and assessment of the Resident(s).

The logistics and resources of how training fits into the function of the department also need to be considered. For example the Clinical Supervisor and Chief Physicist should discuss:

- allocation of time on equipment during normal working hours for training and/or assessment (if possible)
- allocation of overtime funding or flexibility for the Supervisor and other staff involved in the clinical training to take "time-off in-lieu" for training conducted outside normal working hours which may be necessary so that the Resident can gain additional access to equipment
- allowance for clinical supervision workload when distributing roles and responsibilities in the department
- acknowledgement of the importance of the clinical supervision role to the Resident and department.

6.4. ROLES AND RESPONSIBILITIES OF CLINICAL SUPERVISORS

The clinical supervisor's responsibilities include:

- Ensuring that the Resident is trained in all significant aspects of radiation oncology medical physics by facilitating a structured training programme in keeping with the guidelines and scope of modules and assessment levels to be completed as determined by the National Steering Committee. Note that this does not mean that all the training is done by the supervisor. It is the responsibility of the supervisor to ensure that suitably qualified specialists undertake the training of the Resident in the various facets of the programme. For further guidance on this please read Section 6.9 "Models of Supervisory Practice".
- Meeting regularly with the Resident to discuss progress (including reviewing deadlines) and adequate supportive and corrective feedback to the Resident such as the level of competency achieved and competency achievements which have fallen behind.
- Providing a six monthly report on the Resident's progress to the National Programme Coordinator.
- Ensuring that the Resident's clinical training and performance is monitored, documented, assessed and reported as required.
- Ensuring that the in-service clinical training is provided to a standard acceptable to the National Steering Committee and providing to the Resident support where required.
- Ensuring that the Resident is placed in other hospitals, where possible, for short periods to gain experience in techniques or the use of equipment not available in the Resident's own department.
- Ensuring that the Resident has sufficient opportunity to prepare for all assessments required as part of the programme.
- Facilitating external assessments of Residents during their training where possible.

Clinical supervisors should be life-long learners themselves. It is also recommended that every Clinical Supervisor attends a "train the trainer" workshop (if possible) to understand the educational framework of the Clinical Training Guide prior to commencement of training.

6.5. NATURE OF A SUPERVISOR

Clinical education (best) occurs in an environment supportive of the development of clinical reasoning, professional socialisation and life long learning, (McAllister 1997). Supervisors should reflect on what helped them learn during their own training and use their own experiences as one guide to providing the best practice in clinical training.

The attributes required of a good supervisor are varied and are listed below:

- **As a manager**
  The supervisor needs to be organised and to provide clear guidance of expectations, clinical work roster, deadlines and assessment criteria to the Resident. In addition the supervisor needs to liaise with other department and external personnel to ensure that the clinical training and day-to-day supervision are not impeded.

As an instructor

- Components of instruction for a Clinical Supervisor include:

  - the Supervisor demonstrates to the learner.
  - the Resident practises while the Supervisor offers feedback.
  - the Supervisor provides support that is gradually reduced as the Resident becomes more proficient.
  - the Resident describes his or her problem-solving processes.
  - the Resident reflects on the comparison between individual problem-solving processes with those of a peer or more experienced physicist
  - the Resident moves to independent problem-solving

  This process is shown schematically in Fig. 6.2 which also indicates how competency assessments fit with this Supervisor-Resident interaction.

  Other facets of instruction include:

  - providing suitable conditions for self-directed learning
  - directing the Resident's attention towards significant factors of a task (and order of a group of related tasks).
  - imparting the hidden secrets of mastery, rather than just the mechanics of a task
  - ensuring basic knowledge and skills are mastered before more complex tasks are undertaken.

- **As an observer**
  The Clinical Supervisor should take every opportunity to observe the Resident undertaking tasks. This is not only important in the provision of timely supportive and corrective feedback but should be a key element of the assessment process.

- **As a mentor**
  This role may be undertaken by a person other than the Clinical Supervisor. It is important that the "mentor" is someone that the Resident chooses to perform this role.

  Residents are often young adults experiencing considerable social and financial pressures. A mentor may be requested to discuss a Resident's personal issues and should take time to understand the background of the Resident without invading their privacy. If a Clinical Supervisor is willing to act in this role and the Resident agrees, then the Supervisor must only counsel within his own limitations and skill level. If the Resident requires assistance outside a mentor/Clinical Supervisor's skill level, comfort zone or ethical/confidentiality/privacy/assessment role boundaries then they should refer the Resident to the Chief Physicist or Hospital/University Counselling Service. Furthermore, the Clinical Supervisor should encourage or at least make the Resident feel comfortable to seek external help if required.

- **As a giver of feedback**
  Feedback to Residents should consist of supportive as well as corrective feedback. It should also be varied, non-judgemental, specific, focussed on changeable behaviour, descriptive, prompt and private (if professionally appropriate or if the Resident is

sensitive to corrective feedback). The Clinical Supervisor should note that questioning often facilitates discussion of corrective feedback (e.g. "how do you think you went?").

- **As an assessor**

  The role of assessor of clinical competency is one of the most important and difficult responsibilities of the Clinical Supervisor. "Transparency" of the assessment is essential and requires that the Resident:

  - is provided with a clear statement of expectations (knowledge and skill level required) to be successful (The *Clinical Training Guide* includes some detail related to assessment of the level of competency achieved)
  - understands the reasons for the level assessed (what was done well, deficiencies in knowledge or skills). It is good practice to explain why the level was chosen and not a level either side, for example if assessing a competency at level 3 then explain why level 2 or 4 was considered to be inappropriate.
  - is provided with supportive feedback following the assessment of any aspect of clinical training (competency, assignment etc).

  The "validity" of the assessment is also important. The logbook can perform a vital role in assessment by demonstrating the tasks that contributed to completion of competencies.

  The role of the instructor and/or assessor can be delegated by a Clinical Supervisor to other suitably qualified medical physicists (or other professionals in the case of imaging and radiobiology) if the Resident is working in an area of their clinical responsibility. For example, a resident may work under and be assessed by a medical physicist responsible for brachytherapy. For further guidance on this please read Section 6.9 "Models of Supervisory Practice".

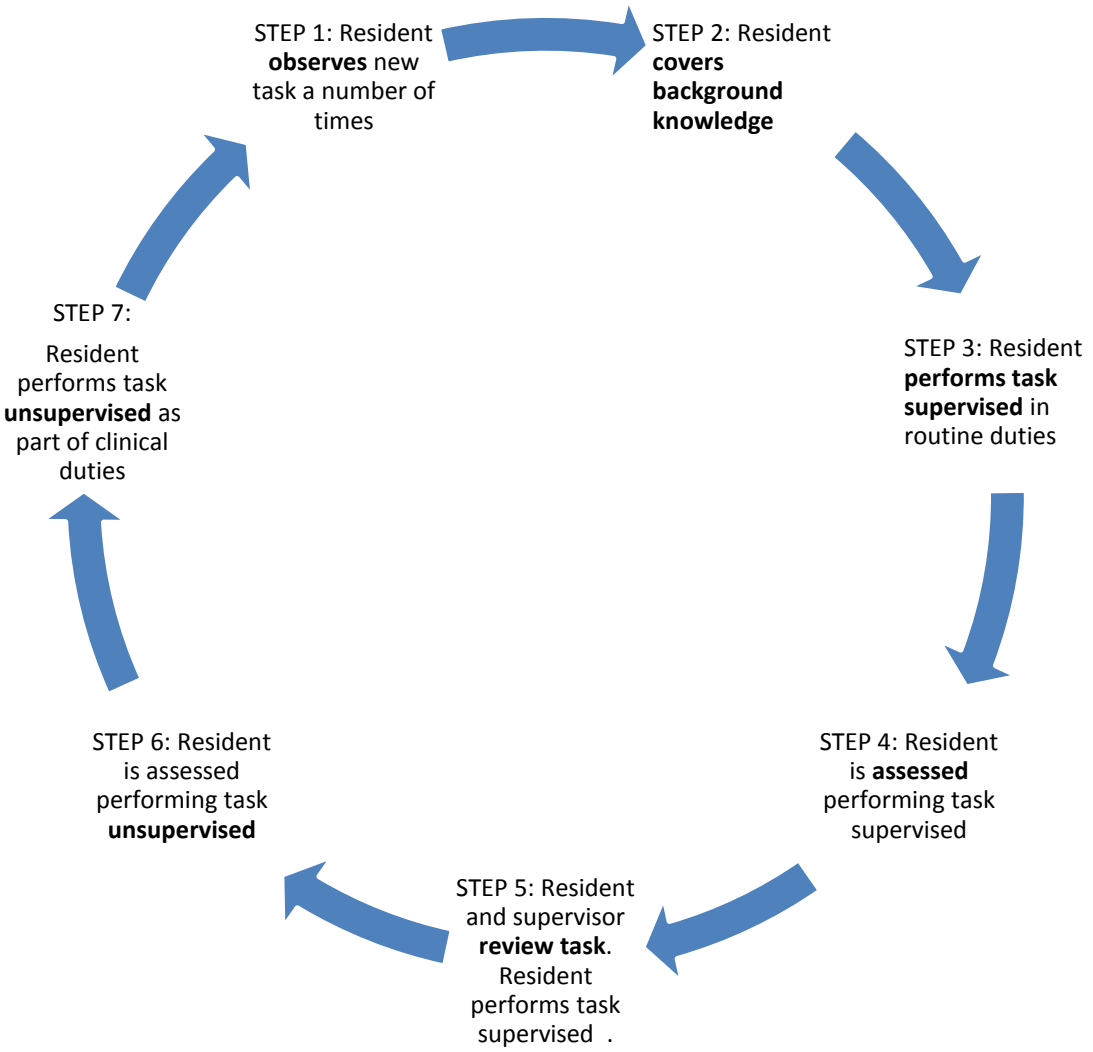

FIG. 6.1: Timeline of clinical training and competency assessment. Step 4 to Step 5 may occur after the Resident has had some experience.

6.6. RESIDENT RECRUITMENT

Before recruiting a Resident you should ensure that

- your department is approved by the National Steering Committee for clinical training of Residents in this programme.
- the prospective Resident has submitted a completed "Application for Entry" form and that this application has been approved by the National Programme Coordinator and the external coordinator in the case of involvement in a pilot programme.
- you have read the Clinical Training Guide and are aware of the scope of modules and assessment levels adopted in your country
- the prospective Resident has a clear understanding of the expectations and duration of the clinical training programme

6.7. NEW RESIDENT ORIENTATION

In addition to the regular hospital and departmental orientation, a new Resident should be given an orientation to the Clinical Training programme in his country. Before this orientation he should read the Clinical Training Guide.

The first meeting between the Clinical Supervisor and new Resident should cover the following aspects.

- Explanation of the Clinical Supervisor's role
- Expectations for the Clinical Training Programme
- Responsibilities of the Resident in the Clinical Training Programme,
- The evaluation and assessment schedule (including a regular time for at least monthly meetings).
- Notification of the timing of external assessment including annual reviews
- Direction to resources (e.g.. sample assignments, access to basic text books, etc)
- Availability of scholarships and other funding to attend courses and conferences
- Requirement to attend seminars, clinical meetings and level of participation expected
- Role of National Programme Coordinator and other relevant persons outside the department
- General employee duties and responsibilities
- Questions from the Resident

In this meeting you should discuss and provide your Resident with the following training materials:

- Draft learning agreement including training schedule for the first six months.
- Resources for appropriate documentation requirements

A checklist is provided in Form 1 CHECKLIST FOR NEW RESIDENTS to ensure all key aspects are covered.

6.8. RESIDENT AGREEMENT WITH SUPERVISOR

Within the first two months a new Resident and his/her Clinical Supervisor should finalise the learning agreement, including learning needs, schedule of training, objectives, resources and

strategies. Learning agreements should include a schedule for achievement of specific competencies in the next 6 months as well as an overview of the schedule for completion of the entire training programme. The Resident should be made aware that the schedule may need to be changed.

Requirements including the scope of competencies and the assessment criteria should be discussed.

The advantages of a learning agreement include:

- Identifying learning needs and resources,
- Providing a forum for discussion of the feasibility of goals relative to the timing and size of workload for the department, Supervisor and Resident,
- Encouraging communication between the Resident and Supervisor,
- Giving the Resident a sense of ownership and commitment to the plan and it is clearly conveyed that they need to take responsibility for their own learning,
- Creating and implementing a strategy which is important due to the volume and scope of work to be completed in the training programme, and
- Prompting evaluation.

Disadvantages include the need for regular updating of the plan as timing of a significant portion of clinical training may be difficult to predict.

As soon as practical, a plan for successful completion of the clinical training programme on schedule should be developed, identifying

- Short, medium and long term learning outcomes
- Timing of final (national) assessments to permit prioritization of competency completion
- Timing of research and clinical requirements, including courses and conferences
- Timing of clinical rotations, such as Imaging and other Radiation Oncology Treatment Centres
- Level of independence required
- A contingency plan for spare time e.g.. assignments or knowledge-based competencies
- Potential issues or situations that may impact on the training experience, such as major changes within the department.
- Opportunities for practice-based learning. For example, attending machine break-downs to observe trouble shooting,

However, the Supervisor and Resident should choose a document that suits their style and is not too time intensive (relative to their needs). An alternate method can be chosen as long as it conveys all the required information and prompts the allocation of resources and staff to support the clinical training.

The learning agreement must be mutually agreed upon as it has to be feasible for both parties and acknowledge the responsibility of both Resident and Supervisor to meeting deadlines. It should take into account departmental and supervisor requirements.

After being accustomed to an academic environment, many Residents struggle with time management when they commence their clinical training programme. A Clinical Supervisor should assist the Resident in developing time management skills.

Form 2: ANNUAL CHECKLIST FOR RESIDENTS and Form 3: COMPLETION CHECKLIST FOR RESIDENTS are two further checklists to prompt discussion and completion of requirements.

6.8.1. Compliance

At regular and six monthly progress review meetings, the learning agreement should be examined. If there is an identified lack of progress by the Resident, the reasons behind the delay need to be determined. Hence the learning needs, objectives, resources and strategies should be re-examined, including:

- An examination of the clinical learning environment to ensure that the environment is conducive to learning. In some cases delays may be due to a lack of initiative, unwillingness to accept responsibility, inability to manage the competing demands in the workplace, Resident immaturity resulting in unsafe practice.
- Development of a mutually agreed action plan to provide the Resident with specific guidance and support to facilitate progress. The action plan must be documented and should detail the following:
    - Agreement as to the exact area/s where problem/s are identified
    - Specific details of how the problem area/s will be addressed
    - An agreed period of time for further supervised practice
    - An agreed minimum contact time per week that the Supervisor and Resident will practice together.

A record of the meeting should be made.

A Supervisor cannot be held responsible for not completing competency assessment before a deadline if the Resident did not meet milestones or submitted a significant amount of work for assessment at the last minute. It is recommended that a Resident and Clinical Supervisor should not schedule a significant amount of competency assessment within the final months of the training programme so as to minimise the possibility that unexpected events such as an increase in department workload, leave, staff shortages, etc might prevent completion of competencies and assessment prior to final exams.

6.9. MODELS OF SUPERVISORY PRACTICE

When first enrolling, the Residents may be passive and used to being "spoon-fed" at university. They may need guidance on appropriate conduct at work and style of communication with multidisciplinary professionals (internal and external) and with patients. As they progress through the programme, the Residents must become more active and self-directed and accept a greater level of responsibility. It is part of the role of a Clinical Supervisor, with the assistance support through mentorship, to guide the Resident through this professional development. One approach to clinical training and competency assessment is shown schematically in Fig. 6.2.

As in the past, a Resident trains "on-the-job" under the direction of experienced staff. However the difference with the previous "ad hoc" approach is that the Resident's clinical

training is structured, follows a set of knowledge and competencies and is monitored internally and externally more closely.

There are two main models of Supervision. However one supervisor model is not always appropriate throughout the programme and for all Residents. The two models of supervision are:

1. "Qualified medical physicists specialising in radiation oncology per Resident" approach – the majority of training and assessment is performed by the one medical physicist. This is difficult when the Clinical Supervisor is very senior in the department and/or works restricted hours. This approach is more common in small centres.

2. "Qualified medical physicists specialising in radiation oncology per module" approach - the Supervisor acting as a local coordinator delegates training and assessment of specific competencies to alternative experienced medical physicist. This approach is more common in larger centres. The local coordinator allocates competencies and reviews progress and assessment, compiles six monthly supervisor reports (in consultation with the other medical physicists involved in training) and communicates with the National Programme Coordinator. In some cases the local coordinator does all the competency assessment which increases the validity of assessment as it is independent of the medical physicist who performed the training. The latter role is difficult when the Clinical Supervisor is a Chief Physicist or works restricted hours. Note: The Clinical Supervisor is not required to do all the training and assessment. However, they are responsible for ensuring appropriate training and assessment is carried out according to the national guidelines.

6.10. ASSESSMENT

There are several components to the assessment of a Resident.

- **Competencies** (as per the sub-modules of the Clinical Training Guide)
  Each sub-module defines a unified portion of clinical knowledge or skills. All competencies (or sub-modules) required are listed in the Clinical Training Guide. The sub-modules to be undertaken and the level of competency required to be achieved in each sub-module have been determined by the National Responsible Authority, or its delegate, and are indicated in the Clinical Training Guide.

  The Clinical Supervisor can schedule competency assessment at any agreed time. The sub-modules can be undertaken in any order and more than one module can be undertaken at a time. The assessment should comply with the learning agreement and focus on one or a number of the following factors:

  - **Clinical work**, i.e. qualified staff formally observe routine clinical tasks as ongoing assessment of competence,
  - **Module-focussed**, i.e. clinical work is assigned and responsibility given once the competencies within a particular module are covered, e.g. responsibility for checking treatment plans can be given once all related planning competencies are completed.

- **Commissioning-focussed**, i.e. scheduling of competencies is related to departmental commissioning projects. This is opportunistic learning and may incorporate several areas of competencies.

It is expected that many competencies will be assessed on several occasions. For example: a particular competency might be worked on for some time and the Resident assessed as having obtained a level of 3. The Resident might then be rostered to another area and return to work on the first competency (sub-module) at a later time with a second assessment being conducted at the end of this period.

The competency assessment criteria are provided in the Clinical Training Guide and hence are known to the Resident. As demonstrated by the criteria, competency assessment is not just reviewing technical ability but also attitudes, such as safe practice and communication skills, expected of a qualified medical physicist.

To increase the validity and uniformity of competency assessment, it is desirable that all clinical supervisors should meet regularly to discuss the criteria and standards. External marking of written and practical assignments (with feedback provided) are highly desirable. External competency testing, whilst a Resident is rostered to another department, also encourages uniformity.

- **ASSIGNMENTS**

  Three assignments must be submitted during the training programme. These should be submitted no later than approximately 9, 15 & 21 months after commencement of the training programme. (This schedule for submission may be altered by the National Steering Committee) These assignments will be marked by an appointee of the National Steering Committee and possibly by an external reviewer nominated by the external coordinator and be returned to the Resident so as to provide feedback to the Resident. The Clinical Supervisor should discuss the feedback received with the Resident

  The assignments will be graded on a 5 to 1 scale with grades of 4 and 5 being unsatisfactory, 3 just satisfactory, 2 good and 1 excellent.

  When a grade of 4 or 5 is awarded the Resident will be required to modify the assignment, taking into consideration the feedback provided, and to resubmit the assignment within 1 month for further assessment.

- **WITTEN and ORAL EXAMS**

  This is administered by the National Steering Committee at the end of the training programme. Before taking the oral and written exams a Resident must satisfactorily complete ALL other aspects of assessment. The content of these exams will be drawn from the Clinical Training Guide.

- **PRACTICAL EXAM**

  The practical exam is optional (i.e. at the discretion of the National Steering Committee) and, is ideally linked to a professional accreditation process The practical

examination is based on scenarios that a medical physicist may encounter at a senior level and incorporates a range of competencies covering the Clinical Training Programme.

- **A LOGBOOK** is obligatory and is included in the assessment process. The logbook should be maintained by the Resident and contain a record of training experiences with comments as to difficulties experienced and positive learning outcomes. The logbook can also be utilised by the Supervisor to demonstrate sufficient work has been covered to sign off a competency if it is difficult for the Supervisor to perform practical assessment of that competency.

NOTES:

- The Clinical Supervisor must have an objective and impartial approach and not be biased when assessing a Resident.
- The Resident must be assessed as satisfactory in each of the above components to be successful in the total programme.
- The required level of competency in ALL sub-modules must be achieved before the oral and written exams can be attempted.
- The oral examination, and practical examination if required, are designed to assess whether the candidate has the appropriate approach of a qualified medical physicist i.e. to work unsupervised in a professional, scientific and safe manner. However as limited technical knowledge and competency can be assessed in these examinations, for the assessment of the majority of the medical physicist's roles and responsibilities it is the assessment of competency in actual practice which has a pivotal role in ensuring safe, competent practice.

6.11. EXAMPLES OF COMPETENCY ASSESSMENT TOOLS

- Observe, listen, question during routine clinical experience
- Listen to Resident teaching someone else
- Mock scenarios
    - communication with patient or colleague (perhaps also a patient based dilemma, e.g. brachytherapy patient who doesn't speak the local language)
    - write a commissioning schedule for a new linear accelerator
    - commissioning an orthovoltage therapy unit
    - commissioning a HDR afterloader
- Attend an internal course on conflict management
- Attend a university course for postgraduate students on oral presentation.
- Ask a patient or another professional's feedback of how the Resident communicated with them.
- Oral assessment in a regular Supervisor-Resident meeting (however performance anxiety may reduce the validity of assessment particularly early in the programme).
- Short written report with assessment and constructive feedback
- Practical assessment which includes oral questioning whilst a Resident performs a routine task (e.g.. quality assurance, absolute calibration)
- Objective, structured clinical examinations or series of defined clinical tasks.

- Logbook review demonstrates degree of exposure to certain tasks.
- Clinical project work
- Patient or equipment trouble-shooting case studies
- Resident lists key steps involved in completing a task
- External competency test at another department
- Problem based learning programme
- Local tutorial programme
- Self-reflection. The supervisor can ask "how do you think you went?" and provide feedback. A supervisor may also provide criteria for a task to allow the Resident to self assess.
- Presentation to departmental staff
- Write sample letters that are assessed by the supervisor on key points.
- Report on the role of other professional groups.
- Report on the pathway of a patient from diagnosis to treatment.
- Compile decision-making diagrams.
- Critical appraisal of journal articles in Journal Review Meetings.

NOTE: Competency assessment demonstrates normal achievement of goals and doesn't always encourage Residents to extend themselves to achieve their full potential.

6.12. RESIDENT MOTIVATION

Success of the clinical training programme relies on the Resident undertaking self-directed study including determining and meeting deadlines (i.e. individual accountability). Difficulty completing the programme is expected to be encountered when the Resident has low initiative and/or is slow to accept responsibility. In contrast, pathways for advancing talented and/or experienced Residents before their recommended completion date need to be considered.

It is recommended that Supervisors document all lapsed deadlines and unacceptable behaviour. Serious concerns must be discussed with the Resident. If necessary, co-opt another party e.g. a mentor, Chief Physicist or National Programme Coordinator to participate in these discussions

If a Supervisor has met the requirements of their position but the Resident continues not to achieve the required standard and/or goals, this may be due to a number of reasons. Strategies for addressing some of these issues are indicated in the table below.

Table 6.1. Resident Motivation Strategies

	ISSUE	STRATEGY IDEAS
A	A new Resident has difficulty knowing where to start, what to do and how to put it together and therefore may struggle if thrown "in the deep end".	-Start with basics and increase the complexity as the Resident's level of understanding improves (if feasible). -Supervisor organises more one-on-one time to explain their thought processes for troubleshooting.
B	Learning activities are different to the learning style of the Resident.	-Tailor learning activities to the learning style and maturity of the resident if possible (e.g.. visual learners). -Explain expectations of self-directed learning to those Residents used to didactic learning. -Set shorter, more regular, deadlines for achievement of milestones.
C	Assumed prior knowledge or experience doesn't exist.	-Start with more basic activities (if feasible).
D	Personal issues (relationship issues, mental or physical health problems, financial difficulties, remote from family, etc),	-While in some cases a mentor can assist, these issues are often best referred to the hospital/university counsellor or chief physicist. -Review and re-design the learning agreement to give the Resident time to adjust to a new environment.
E	Difficulties communicating expectations between supervisor and Resident	-Write down each others perspectives and try to understand the other point of view. -Ask the Resident to repeat instructions to determine if they have interpreted your instructions correctly. -Resident to work under another medical physicist (internal or external) for a period of time.
F	Resident has difficulties communicating effectively with others in the Radiation Oncology Department.	-Mock scenarios to practice appropriate communication styles (for staff and patients). -Encourage participation in social activities which minimise isolation. -Resident to attend "Communication skills" courses including "Communicating with others" or "Conflict resolution" course if relevant.

Table 1 (cont.). Resident Motivation Strategies

G	Resident shows lack of initiative	-Balance the positive and critical feedback carefully. -Review and re-design the learning agreement to include shorter and more regular deadlines to achieve milestones. -Identify activities related to Resident's value system to draw out enthusiasm. -Increase clinical interaction time to draw them away from their desk. -Open/honest discussion of expectations. -Allocate an area of responsibility to the Resident if he feels indifferent as he does not have his own niche. (if appropriate) -Exercise peer-support system with another Resident. -Use formative assessment if feasible. Anxiety can be created from a lack of regular assessment or feedback.
H	Not willing to work out of hours	-Discuss conditions of employment and relevant issues (e.g.. personal) if progress is behind schedule.
I	Difficulties managing competing priorities	-Regular meetings with Resident to review the Resident's work/ priorities. -Time management course.
J	Difficulties with scientific thinking and is more suited to a technically-based profession	-Explain expectations. -Start with basic scenarios and increase the complexity as their level of understanding improves (if feasible). -Supervisor organises more one-on-one time to explain their thought processes for troubleshooting. -If unresolved, refer them to their mentor to review career options. -Stop the placement.
K	Difficulties identifying opportunistic learning avenues.	-Supervisor, initially, identifies avenues for opportunistic learning as often such opportunities are one-off and not planned. This should be for a limited period only. -Allow them to work with someone (RT, engineer, medical physicist) for a period of time. -Increase clinical interaction time. -If appropriate, make them responsible for an item of equipment for a period of time.

6.12.1. If a Resident fails to meet required standards

Termination of the clinical training position should be considered if the Resident fails to meet the standards required in the programme following a period of supportive and corrective feedback and opportunity to improve. If this does occur, do not feel as though you have failed the Resident. Rose and Best (2005) note *"you don't fail the Resident….the Resident fails the assessment. In a well-developed assessment system with clear expectations and criteria, adequate feedback for the student and opportunities for improvement, the student should have had every opportunity to achieve the desired standard".*

6.13. CLINICAL ROTATIONS

The Resident may require training in other training hospitals for periods of time to gain experience in techniques or on equipment not available in the Resident's own hospital. The clinical training guide also requires the Resident to gain knowledge and competencies in Radiology and Nuclear Medicine.

Aspects to consider when rotating Residents to other departments include:

- Workload and staffing levels of your and the Host departments.
- Time constraints imposed by completion of the clinical training programme, and
- Distances to be travelled by the Resident.
- The pre-requisite knowledge should be completed before any Clinical Rotation is undertaken.
- The visiting Resident should work on competencies related to the rotation's focus area but must also be flexible enough to work within the busy schedule of the Host department.
- A Resident can visit another department for varying amounts of time, from a day up to months at a time.
- A clinical rotation can also include a competency test conducted by an experienced medical physicist in the Host department.
- The responsibility of organising the clinical rotation and delegation of competency assessment during this placement remains with the Clinical Supervisor.

Departments should approach each other directly to arrange for the rotation of a Resident. You are encouraged to offer a Clinical Rotation to a Resident from another department that may have a deficiency in an area in which your department is strong. Departments should give priority to Residents who have the greatest need and/or shortest time remaining to complete their training. Expectations of both departments and competencies to be addressed should be documented prior to the commencement of the clinical rotation.

6.13.1. Examples of Resident Clinical Rotations

Suggested clinical rotations where local equipment is not accessible or staff is not available:

- Brachytherapy – high dose-rate brachytherapy (HDR) and loose seeds
- Superficial-orthovoltage therapy unit
- Treatment Simulator or CT scanner
- An alternate treatment planning system
- Imaging
- Different manufacturer of linear accelerator
- Stereotactic radiotherapy
- Image guided radiotherapy (IMRT)
- Acceptance Testing/Commissioning

Examples include:

- A Resident visits a Host department one day every 3 months to participate in HDR brachytherapy source changes to further develop the competency to the level required in this area.
- Residents "job swap" for one month so that one Resident can develop skills in brachytherapy planning and the other in IMRT planning. An advantage is that the culture of the Host centre is experienced.
- A Resident familiar with the Siemens linear accelerator attends a QA down day or acceptance testing on another department's Varian or Elektra linear accelerator.
- Afternoon visit to a Host department to participate in QA on a simulator or CT scanner

Note a Resident in the Host department can provide some assistance to a Visiting Resident to alleviate the workload of the department's qualified medical physicists.

6.13.2. Radiology and Nuclear Medicine Clinical Rotations

Supervision and assessment of the Resident in these areas is ideally undertaken by an experienced physicist in these specialties. However, due to the small numbers of Nuclear Medicine Medical Physicists and Radiology Medical Physicists a significant component can be undertaken under the supervision of an appropriate professional (e.g. Nuclear Medicine Technologist, Radiologist, Radiographer, etc).

6.14. Bibliography

MCALLISTER, L., (Ed.) Facilitating learning in clinical settings, Stanley Thornes, Cheltenham, UK, (1997).

ROSE, M., BEST, D., (Eds), Transforming practice through clinical education, professional supervision and mentoring, Elsevier, (2005).

6.15. USEFUL RESOURCES FOR CLINICAL SUPERVISORS

CAMPEP www.**campep**.org

EFOMP

- http://www.efomp.org/docs/CurriculumForMP.pdf
- http://www.medfys.no/misc/EFOMP-Policy1upd_draft4.doc

Mentoring

- http://www.edu.uwo.ca/conted/mentor/index.asp
- "ACPSEM Guide for Mentors". (2004) Mellish and Associates.
- http://www.uscg.mil/leadership/mentoring/mentguid.ppt#1
- http://www.usfirst.org/uploadedFiles/Community/FRC/Team_Resources/Mentoring%20Guide.pdf
- http://www.mentorlinklounge.com/

Clinical Supervision

- "Teaching on the run" is something that physicians, RTs and physicists all have in common when providing clinical training (see Table II.2). http://www.mja.com.au/public/issues/contents.html

Table II.2

Teaching on the run tips 1: doctors as teachers	MJA 2004; 181 (4): 230-232
Teaching on the run tips 2: educational guides for teaching in a clinical setting	MJA 2004; 180: 527-528
Teaching on the run tips 3: planning a teaching episode	MJA 2004; 180: 643-644
Teaching on the run tips 4: teaching with patients	MJA 2004; 181 (3): 158-159
Teaching on the run tips 5: teaching a skill	MJA 2004; 181 (6): 327-328
Teaching on the run tips 6: determining competence	MJA 2004; 181 (9): 502-503
Teaching on the run tips 7: effective use of questions	MJA 2005; 182 (3):126-127
Teaching on the run tips 8: assessment and appraisal	MJA 2005; 183 (1): 33-34
Teaching on the run tips 9: in-training assessment	MJA 2005; 183 (1): 33-34
Teaching on the run tips 10: giving feedback	MJA 2005; 183 (5): 267-268
Teaching on the run tips 11: the junior doctor in difficulty	MJA 2005; 183 (9): 475-476
Teaching on the run tips 12: planning for learning during clinical attachments	MJA 2006; 184 (5): 238-239
Teaching on the run tips 13: being a good supervisor —	MJA 2006; 184 (8): 414-415

preventing problems	
Teaching on the run tips 14: teaching in ambulatory care	MJA 2006; 185 (3): 166-167

Form-1: CHECKLIST FOR NEW RESIDENTS (0-3 MONTHS OF TRAINING PROGRAMME)

RESIDENT: _____

DATE OF COMMENCEMENT OF RESIDENCY: _____

	✓ When Completed	Date Achieved
ALLOCATION OF A CLINICAL SUPERVISOR		
RESIDENT'S APPLICATION FORM SENT TO NATIONAL PROGRAMME COORDINATOR		
LETTER OF ACCEPTANCE INTO TRAINING PROGRAMME RECEIVED FROM NATIONAL PROGRAMME COORDINATOR		
ORIENTATION BY CLINICAL SUPERVISOR		
RESIDENT STARTS A LOGBOOK		
CLINICAL TRAINING GUIDE PROVIDED TO RESIDENT		
SCHEDULE FOR REGULAR SUPERVISOR-RESIDENT MEETINGS ESTABLISHED (at least monthly)		
INITIAL 6 MONTH TRAINING PLAN AGREED		
TRAINING PLAN FOR PERIOD OF ENROLLMENT DEVELOPED AND AGREED WITH CLINICAL SUPERVISOR		
RESIDENT BEGINS ATTENDANCE AT CLINICAL MEETINGS AND/OR TUTORIALS		

Form 2: ANNUAL CHECKLIST FOR EXPERIENCED RESIDENTS

RESIDENT: _____

YEAR: **20____**

	✓When Satisfactory	Comment
REGULAR SUPERVISOR-RESIDENT MEETINGS HELD (at least monthly)		
RESIDENT LOGBOOK UP TO DATE		
COMPETENCY ASSESSMENT UP TO DATE		
SIX MONTHLY SUPERVISOR REPORTS COMPLETED (AND FORWARDED TO NATIONAL PROGRAMME COORDINATOR		
ANNUAL REVIEW & REPORT ON FILE		
ANNUAL TRAINING PLAN UP TO DATE		
TRAINING PLAN FOR PERIOD OF ENROLLMENT UP TO DATE		
RESIDENT REGULARLY ATTENDING CLINICAL MEETINGS AND/OR TUTORIALS		
ASSIGNMENT FOR THIS YEAR COMPLETED		

Form-3: COMPLETION CHECKLIST FOR RESIDENTS

RESIDENT: _____

COMPLETION OF REQUIREMENTS CHECKLIST	✓ When Completed	**Date Achieved**
REQUIRED LEVEL OF COMPETENCY ATTAINED IN ALL SUB-MODULES		
LOGBOOK COMPLETED AND ASSESSED AS SATISFACTORY		
THREE ASSIGNMENTS COMPLETED AND GRADED AS 3 OR BETTER.		
ORAL EXAM CONDUCTED AND ASSESSED AS SATISFACTORY		
WITTEN EXAM CONDUCTED AND ASSESSED AS SATISFACTORY		
PRACTICAL EXAM CONDUCTED AND ASSESSED AS SATISFACTORY (IF REQUIRED)		

7. IMPLEMENTATION GUIDE

7.1. ESSENTIAL REQUIREMENTS FOR SUCCESSFUL IMPLEMENTATION OF THE CLINICAL TRAINING PROGRAMME.

7.1.1. Programme management

7.1.1.1. National

The programme should be recognised by a national authority such as the Medical Physics Professional Body, the Ministry of Health, the Ministry of Education or the National Atomic Energy Authority. The national authority is referred to as the ***National Responsible Authority*** (NRA) in this manual.

The National Responsible Authority provides **formal recognition** of the qualification "Radiation Oncology Medical Physicist" (or equivalent) and the requirements to become one.

The programme should be managed by a ***National Steering Committee*** comprising of representatives from the relevant Medical Physics Professional Body (where one exists) and other relevant interest groups and stakeholders. It is highly recommended that Radiation Oncology Medical Physicists should form the majority of members in the Committee.

In managing the programme the National Steering Committee must:

- Appoint a ***National Programme Coordinator*** to oversee the implementation of the project (appointment of several Programme Coordinators may be justified in large countries where regional coordination is necessary). The National Programme Coordinator should, ideally, be a person engaged in the practice of radiation oncology medical physics.
- Establish a ***Support Group*** of individuals who agree to assist with Resident training. The support group may include radiation oncologists, radiation oncology medical physicists and personnel from educational institutions. Ideally, at least one radiation oncology medical physicist who is external to the country should be a member of the support group.
- Ensure that guidelines for participation in the clinical training programme are strictly followed by both the clinical departments and the Residents.
- Ensure that standards for assessment are set and maintained.
- Maintain records of Residents' progress.
- Issue certificates that provide an accurate record of a Resident's performance.
- Implement an annual survey of departments and Residents of progress of the training programme.
- Report to the external coordinator on progress of the programme.
- Develop a process for appeals and complaints.

The National Responsible Authority, having been assured that the National Steering Committee has fulfilled its responsibilities outlined above, should provide formal recognition of the qualification awarded.

7.1.1.2. External

The programme is to be piloted in selected countries and departments for a trial period of several years. For these pilot programmes an external management structure will be formed to coordinate external support and to oversee the general conduct of the programme. The external management structure includes an external coordinator and external reviewers.

The external coordinator may assist the programme in the following ways:

- Review the entry qualifications of applicants for the training programme
- Consider Resident numbers in relation to department resources including arrangements for supervision of the Resident(s)
- Review Residents' Progress
- Coordinate the use of external reviewers
- Consider and deal with issues raised by the external reviewers
- Consider difficulties encountered and recommend remedial action to be taken
- Provide advice to the National Programme Coordinator and National Steering Committee
- Coordinate the assessment of the programme and compile statistics on the programme on an annual basis
- Promote the sustainability of the national clinical training programme

The external coordinator will work closely with the National Programme Coordinator and National Steering Committee to ensure the smooth operation and success of the programme.

The role of the external reviewers may include:

- Monitoring of the progress of individual Residents
- Reviewing a Resident's work plan
- Liaising with clinical supervisors.
- Reviewing items of assessment of a Resident
- Giving presentations to medical physicists and Residents

7.1.1.3. ARASIA Regional Pilot Program

The programme will be regionally piloted at King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia, for several years. The program is be managed by a Residency Steering Committee (RSC), composed of 9 members, including 2 ARASIA medical physicists from other ARASIA Member States, but not from the host.
It is recommended that ARASIA Member State undertakes to recognise the successful graduates of such a regional programme as clinically trained medical physicists. An IAEA expert acts as an External Advisor to the ARASIA Regional Pilot Program and its RSC. The formation of an Assessment Committee will be setup by the RSC. The RSC meets twice per year, with additional meetings, as needed, to be conducted through electronic means.

7.1.2. Basic requirements for departments where residents are located

7.1.2.1. Clinical Supervisor

The department must provide any Resident with a supervisor who is clinically competent in radiation oncology medical physics. The number of residents in a department should normally not exceed the number of clinically competent medical physicists in that department. More detail concerning the requirements for supervision are provided below (section 7.3).

7.1.2.2. Resources

It is important that the Resident is trained in the full range of a medical physicist's duties and hence a department participating in the training programme must have:

- A teletherapy unit
- A 3D treatment planning system
- A simulator (conventional and/or CT), and
- Calibrated dosimetry equipment, including a scanning water phantom.

The department must also have on-site or be prepared to rotate Residents to other departments with:

- Brachytherapy, and
- Medical imaging facilities.

7.1.2.3. Clinical service

The Resident must practice in a department that offers a full range of radiation oncology services and which employs medical practitioners trained in radiation oncology.

7.2. ENTRY REQUIREMENTS FOR RESIDENTS

It is expected that a Resident in this programme shall:

- have a university degree in physics, engineering or an equivalent physical science, and
- have a minimum of Master's degree in medical physics, and
- be accepted as a medical physics resident and working in a radiation oncology clinical environment.

Note 1: In exceptional cases, a candidate with a Master's degree in an equivalent speciality can be admitted into the program by special approval from the Steering Committee and/or external coordinator during the pilot process. In this case, remedial course/work may be required.

Note 2: Clinical experience during any graduate program is NOT counted towards the 2-year residency

7.3. REQUIREMENTS FOR SUPERVISION OF RESIDENTS

A suitably qualified and experienced Clinical Supervisor should be appointed by a department seeking to participate in the ARASIA pilot of the clinical training programme. The supervisor should be a person working in the same department as the Resident. Participation of the Resident in the training programme and involvement of the department must be approved by the responsible medical specialist (including a guarantee that the Resident will have the necessary access to equipment).

The supervisor should:

- Have a commitment to the programme
- Be available for consultation with the Resident when needed
- Assist the Resident with access to equipment and all aspects of their training programme
- Maintain links with the National Programme Coordinator to access national resources if required.

Although supervision by a person with experience in teaching is desirable, it is recognized that such a person may not always be available on-site. The role of the supervisor is to facilitate the resident's progress rather than necessarily to provide individual advice on all aspects of the training content. It is recommended that the supervisor attends a relevant train-the-trainer programme in clinical supervision. More details of the roles and responsibilities of the Clinical Supervisor are provided in Chapter 6 *Clinical Supervisor's Guide.*

CLINICAL TRAINING GUIDE

Introduction

This IAEA Guide to Clinical Training in Radiation Oncology Medical Physics is divided into eight modules. Each module defines a unified portion of clinical knowledge or experience required of a Medical Physicist specialising in Radiation Oncology.

The eight modules are:

Module 1: Clinical Introduction

Module 2: Radiation Safety and Protection

Module 3: Radiation Dosimetry for External Beam Therapy

Module 4: Radiation Therapy - External Beam

Module 5: External Beam Treatment Planning

Module 6: Brachytherapy

Module 7: Professional Studies and Quality Management

Module 8: Research, Development and Teaching

The modules are further divided into sub-modules which address particular competencies. The sub-modules to be undertaken and the level of competency required to be achieved in **each sub-module** have been determined by the Responsible National Authority, or its delegate. You should refer to the appendix "*Competency Assessment"* to determine the levels required.

The modules and sub-modules are presented in tabular form. The table for each module includes:

- An objective
- Competencies addressed in the module
- Expected time commitment to the module (Note: This is a guide only. Particular Resident's may take more or less time to acquire the level of competency expected in particular modules).
- An indication of pre-requisite knowledge required (if any) for the module
- A core and supplementary reading list

The table for each sub-module includes:

- An objective for that sub-module
- The competency or competencies addressed in the sub-module
- Recommended items of training.

There are a total of 64 competencies included in the sub-modules. The modules and sub-modules can be undertaken in any order and with more than one module undertaken at a time.

Assessment of competencies should be performed using the assessment matrix for each sub-module provide in the appendix cited above.

Note 1: A resident who has covered certain (sub)modules in other equivalent residency programs (e.g. RCA, CAMPEP, AUSTRALIA), does not have to re-take those parts that are CONFIRMED, ASSESSED and APPROVED by the supervisor and/or the Residency Steering Committee (RSC).

Note 2: The actual times and the sequence for modules are decided by the supervisor and/or the Steering Committee.

	MODULE 1. CLINICAL INTRODUCTION
Objective	**To provide medical physicists with knowledge and clinical experience related to Radiation Oncology.**
Competencies Addressed in this Module	• **A basic understanding of the clinical aspects of Radiobiology** • **A basic understanding of cancer and radiation oncology suitable for medical physicists** • A basic knowledge anatomy for medical physicists • Operating procedures of Radiation Oncology and other clinical departments
Expected Time Commitment	3% to 7% of the entire programme
Sub-modules	1.1 CLINICAL ASPECTS OF RADIOBIOLOGY 1.2 Introduction to Radiation Oncology 1.3 Anatomy 1.4 Patient Related Clinical Experiences
Pre-requisite Knowledge	PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapter 14
Core Reading List	BOMFORD, C.K., KUNKLER, I.H., Walter and Miller's Textbook of Radiotherapy, 6th edn, Churchill Livingstone/Elsevier Science Ltd, Edinburgh (2002). HALL, E., GIACCIA, A.J., Radiobiology for the Radiologist, 6th edn, Lippincott Wilkins & Williams, Philadelphia, USA (2006). PEREZ, C., BRADY, L., (Eds), Principles and practice of radiation oncology, Lippincott Williams & Wilkins, Philadelphia, (2004). STEEL, G., Basic Clinical Radiobiology, 3rd edn, Arnold Press (2002). Applied Sciences of Oncology CDs
	Module 1. Clinical Introduction
	Sub-module 1.1: Clinical Aspects of Radiobiology
Objective	To gain a basic understanding of the clinical aspects of radiobiology
Competency Addressed	A basic understanding of the clinical aspects of Radiobiology
Pre-requisite Knowledge	Nil
Recommended Items of Training	• Demonstrate an understanding of fractionation scheme. • Perform modified fractionation scheme examples. • Perform calculations to account for gaps between fractions. • Perform calculations to convert dose between brachytherapy LDR/HDR and external beam radiation therapy. • Re-treatment examples

	• Awareness of rationale behind treatment options with respect to LET – protons, heavy ions, etc • Dose constraints of normal tissue for treatment planning. • Demonstrate an understanding of Biological Treatment Planning – parameters for different tumour types and potential for individualised treatment. • Understanding of limitations of utilising radiobiology calculations in the clinic. • Understand the radiobiological rationale for combination therapy (e.g. chemotherapy and radiotherapy) and report on patient case studies.
	Module 1. Clinical Introduction
	Sub-module 1.2: Introduction to Radiation Oncology
Objective	To develop a basic understanding of cancer disease and the use of radiation oncology.
Competency Addressed	**A basic understanding of cancer and radiation oncology suitable for medical physicists.**

Recommended Items of Training	• Role of RT in cancer treatment (vs. other modalities)
	• Aim of radiotherapy
	  o Tissue tolerances
	  o Required accuracy
	  o Therapeutic gain
	  o Palliative vs. curative
	  o Clinical "target"
	• Cancer disease and radiation oncology
	  o Demonstrate an understanding of the nature and effects of a tumour on an organ and its function.
	  o Identify the main routes of spread of disease and metastases for common cancer sites.
	  o Identify abnormal size and function of organs due to primary tumours and metastases on radiological, PET and nuclear medicine images.
	  o Demonstrate an understanding of the clinical decision making process of cancer diagnosis of a patient (i.e. relation of presenting symptoms to tumour type).
	  o Demonstrate an understanding of tumour grading and staging.
	• Review the anatomical and physiological changes to the body/organ due to radiotherapy treatment

	Module 1. Clinical Introduction
	Sub-module 1.3: Anatomy
Objective	To develop a basic knowledge of anatomy including surface anatomy and cross sectional anatomy with particular emphasis on the anatomy required for radiotherapy.
Competency addressed	**A basic knowledge of anatomy for medical physicists.**

Assumed knowledge	**Introductory course in Anatomy & Physiology**

Recommended Items of Training	• Cancer and radiation oncology
	  o Demonstrate an understanding of the nature and effects of a tumour on an organ and its function.
	  o Identify the main routes of spread of disease and metastases for common cancer sites.
	  o Identify abnormal size and function of organs due to primary tumours and metastases on radiological, PET and nuclear medicine images.
	  o Demonstrate an understanding of the clinical decision making process of cancer diagnosis of a patient (i.e. relation of presenting symptoms to tumour type).
	  o Demonstrate an understanding of tumour grading and staging.
	• Review the anatomical and physiological changes to the body/organ due to radiotherapy treatment.
	• Identify key anatomical features on CT cross sectional images through body sections.

	Module 1: Clinical Introduction
	Sub Module 1.4: Patient Related Clinical Experiences
Objective	To provide the Resident with broad patient-related experiences and an understanding of the role of multidisciplinary professionals in Radiation Oncology.
Experience Gained	The medical physicist is expected to gain clinical experiences in the following patient-related clinical experiences and compile a short report: • Ward round • Mould room • New patient/review/follow up clinics • Patient case studies • Simulator and/or CT • Treatment planning room • Radiation treatment • Operating theatre • Imaging Department/s
Recommended Items of Training	During these patient related experiences, the medical physicist must gain an understanding of the: • Need for patient care, rapport, privacy and confidentiality during patient related experiences. • Appropriate hygiene/infection control procedures • Effect on patient quality of life • Need for introducing oneself to the patient. • Patient-staff interactions • Interactions and roles and responsibilities of multi-disciplinary professionals involved in patient management. • Interactions with/within Radiation Oncology Department • Patient's and their carers reactions to procedures and management

	• Role of a Physicist in the section/department (where relevant). **Ward Round** • Attend at least two ward rounds with different Radiation Oncologists. • Demonstrate an understanding of the purpose of the ward round • Note the reasons for the patient's admission and their conditions • Understand why only a low percentage of radiation oncology patients need to be admitted to the ward **New Patient-Clinic** • Attend each clinic and at least two patients in each clinic • Understand the purpose of the clinic • Understand the reasons for the patient's attendance • Be aware of clinic outcomes (blood tests, further investigations required, further appointments) • For review patients, note the overall prescription required and the dose and fractionation to date. Be aware of clinical reactions noted and the patient's reaction. **Mould Room** • Attend the manufacture of treatment aids (bolus, shielding, immobilisation devices etc.) of at least four different types • Demonstrate an understanding of the patient diagnosis and the proposed treatment technique. • Demonstrate an understanding of the use of the treatment aid for this patient • Demonstrate an understanding of the physics principles which may be involved with this aid and an awareness of the effect that this aid has on the treatment. • Demonstrate an understanding of potential health hazards that may be involved with the manufacture of this aid and associated safety procedures, including consideration of alternative solutions (other materials or techniques). **Simulator** • Attend a simulator unit or CT scanner for a period of at least three days. • Observe patient advice being provided. • Observe the issues involved in positioning a patient accurately. Compare this with taking physics dosimetry measurements. • Demonstrate an understanding of the patient's diagnosis, investigations, intent for simulation, treatment rationale and prescription over a range of treatment techniques. **Treatment Planning Room** • Attend the treatment planning room for a period of one week • Demonstrate an understanding of the intent of the procedure based on the diagnosis, rationale or treatment, anatomy and any special conditions • Demonstrate an understanding of the planning process from the obtaining of patient geometric and anatomical data through to validation and transfer to the treatment unit. • Demonstrate an understanding of dose optimisation. • Perform a four field treatment plan.

	• Demonstrate a familiarisation with the standard planning protocols used. **Radiation Treatment** • Attend at least one radiation treatment unit for a period of one week. • Identify and understand the components of the treatment record • Observe the issues involved in positioning a patient accurately. Compare this with taking physics dosimetry measurements. • Demonstrate an awareness of the patient diagnosis, prescription, dose delivered to date and current reactions • Compare any port films taken against the intended treatment plan. Consider the impact that any discrepancies might have. • Relate one's own knowledge of the underlying physics principles to the treatment **Case Studies** • Follow at least three patients (representing different treatment sites) from clinic through to treatment. **Operating Room** • Demonstrate understanding of the differences between treatment options (surgery vs. radiotherapy) for cancer patients and the limitations of surgery. • Attend theatre for Oncology-related procedures (e.g. tumour excision, brachytherapy seed implant, etc.) • Perform correct scrub technique. • **Imaging** • This should include both radiology and nuclear medicine • Compile a list of procedures performed for potential radiotherapy patients. • Observe simple and complex diagnostic studies performed on patients (including Oncology patients). • Observe a Specialist reporting on patient images (including Oncology patients). • Observe a member of staff advising a patient on radiation safety aspects. • Observe the use of image transfer and display systems. • Observe the use of shielding in the department. • Observe the safe handling of radioisotopes. • Observe the use of imaging (e.g. gamma camera, PET, SPECT) and support equipment (e.g. phantoms, dosimeters). • Demonstrate an understanding of the department's research and development activities.

	MODULE 2: RADIATION SAFETY AND PROTECTION
Objective	To develop personal and key skills in radiation protection management in a radiotherapy department
Competencies Addressed in this Module	• Understanding of and the ability to apply the principal requirements of radiation protection management. • Ability to assess local radiation protection guidelines and to interpret new guidelines. • Knowledge and skills necessary to perform radiation safety and protection procedures according to local requirements. • Knowledge and skills necessary to perform radiation safety and protection procedures for radiation sources according to local requirements. • Ability to perform the role of a radiation safety officer in a Radiation Oncology department. • Ability to manage disused sources and waste. • Ability to: o Design room shielding in treatment facilities. o Calculate the thickness of the shielding structure • Perform radiation survey and monitoring • Knowledge and skills required to provide protection in relation to medical, occupational and public exposure • Ability to reach correct decisions in emergency situations. • Ability to perform the role of a radiation safety officer or source custodian in brachytherapy and to take appropriate safety and quality control procedures in brachytherapy treatment • Conduct of radiation risk assessment, design of room and source shielding in brachytherapy treatment facilities. Radiation survey and monitoring
Expected time commitment	5-10% of the entire programme
Sub-modules	2.1 Principal requirements 2.2 Local organization 2.3 Procedures 2.4 Safety of radiation sources 2.5 Radiation Protection Design of Treatment Rooms 2.6 Protection against medical, occupational and public exposure 2.7 Emergency situations 2.8 Radiation Safety in Brachytherapy 2.9 Radiation Protection Design of Brachytherapy Treatment Rooms
Prerequisite Knowledge	PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapter 4, 16
Core Reading List	INTERNATIONAL ATOMIC ENERGY AGENCY, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna (1996). INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, 2005 Edition Safety Requirements Details IAEA Safety Standards Series, No. TS-R-1,

	IAEA, Vienna (2005). INTERNATIONAL ATOMIC ENERGY AGENCY, Applying Radiation Safety Standards in Diagnostic Radiology and Interventional Procedures Using X Rays, IAEA Safety Reports Series No. 39, IAEA, Vienna (2006). http://www-pub.iaea.org/MTCD/documents/PDF/Pub1206_web.pdf. INTERNATIONAL ATOMIC ENERGY AGENCY, Setting up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspects, IAEA, Vienna (2008). http://www-pub.iaea.org/MTCD/documents/PDF/pub1296_web.pdf.
Supplementary Reading List	INTERNATIONAL ATOMIC ENERGY AGENCY, Lessons Learned from Accidental Exposures in Radiotherapy IAEA Safety Reports Series No. 17, IAEA, Vienna (2000). http://www-pub.iaea.org/MTCD/documents/PDF/Pub1084_web.pdf. •
	Module 2. Radiation Safety and Protection
	Sub-module 2.1: Principal requirements
Objective	To develop an understanding of the principal requirements required for local radiation protection management
Competencies addressed	Understanding of and the ability to apply the principal requirements of radiation protection management.
Recommended Items of Training	• Analyze and understand the policies for protection and safety as laid down in the QA programme of the local department and compare to national legislation, the International BSS and recommendations by the ICRP • Compile a list of all local documents on radiation protection and compare with relevant international standards • Interpret legislative requirements in the local department such as given by: o number and type of treatment units and/or radioactive sources o patient and machine workload o concerns of previous reviews (if existing) • Write and/or critically review local radiation safety related administrative and management procedures.
	Module 2. Radiation Safety and Protection
	Sub-module 2.2: Local organization
Objective	To develop an understanding and overview of local protection regulations and publications
Competency addressed	Ability to assess local radiation protection guidelines and to interpret new guidelines.
Recommended Items of Training	• Evaluate the application of current laws, regulations and recommendations as applied locally • Describe the local organization of radiation protection: o responsibilities

	○ process of authorization ○ number and individuals having responsibilities for the application of protection standards ○ number and individuals involved in occupational exposures • List local license publications applying to treatment units and explain them with respect to conditions and limitations • Read instructions on radiation protection provided to staff and patients
	Module 2. Radiation Safety and Protection
	Sub-module 2.3: Procedures
Objective	To develop personal and key skills for performing local radiation safety and protection programmes and procedures
Competency addressed	Knowledge and skills necessary to perform radiation safety and protection procedures according to local requirements.
Recommended Items of Training	• Demonstrate an understanding of selection, calibration and principles of survey meters • Perform radiation survey of an area using appropriate dose-rate equipment • Demonstrate an understanding of selection, calibration and principles of individual radiation monitors • Compile the steps relevant to radiation protection to be performed during acceptance tests and commissioning of a treatment facility • Understand the various interlocks required on radiotherapy equipment, including remote afterloading brachytherapy equipment • Compile and monitor local relevant operation instructions for equipment and facilities • Translate examples of existing operating instructions from major world language into local language if applicable
	Module 2. Radiation Safety and Protection
	Sub-module 2.4: Safety of radiation sources
Objective	To develop personal and key skills in the handling of radiation sources used in Radiation Oncology.
Competencies addressed	• Knowledge and skills necessary to perform radiation safety and protection procedures for radiation sources according to local requirements. • Ability to perform the roles of a radiation safety officer in Radiation Oncology • Ability to manage disused sources and waste.
Recommended Items of Training	• Perform an inventory of all sources in the department • Compare your own inventory with the department's keeping and record system • Compile relevant international (IEC) or national standards for source equipment applicable to radiotherapy • Demonstrate an understanding and perform a design of a safety

	system/code of practice for radiation sources, covering: ° Storage security and safety ° Source inventory system ° A book keeping system for tracking source movement, such as for delivery, storage, release for clinical application, disposal ° Labelling ° Transportation ° Local legislative requirements and international recommendations on quality and safety standards of radiation sources • Demonstrate a safe operation of source related equipment • Perform leak tests on radioactive sources • Demonstrate an understanding on potential hazards and risks, with particular emphasis on brachytherapy • Conduct radiation risk assessment • Design radiation emergency procedures, including o Fire o Brachytherapy equipment malfunction o Loss of radioactive source • Perform: o Regular source inventory check o Leakage test of sources o Testing on integrity of the: – Treatment interlocks of afterloading equipment – Area radiation monitoring and warning systems • Supervise/monitor and record the transfer of sources • Advise on: o Compliance with legislative requirements, including licence application o Safety and protection measures o Proper use of protective equipment and handling tools • Report of incident involving radiation o Prepare record and documentation • Investigate how principles of waste disposal operate locally • Exercise the return procedure of empty packages • Exercise the return procedure of a disused source
	Module 2. Radiation Safety and Protection
	Sub-module 2.5: Radiation Protection Design of Treatment Rooms
Objective	To develop the skills required for all radiation protection measures for radiation treatment rooms for external beam therapy and brachytherapy
Competencies addressed	Ability to: • Design room shielding in treatment facilities. • Calculate the thickness of the shielding structure • Perform radiation survey and monitoring
Recommended Items Of Training	• Demonstrate an understanding on the: o Local legislative requirements on radiation safety and protection o International standards and recommendations o Nature of source and equipment to be installed o Nature and types of the treatment services to be provided

	○ Source strengths to be used ○ Projected patient load ○ Room layout requirements taking into consideration the requirements for sterility, patient flow, work flow, staff manoeuvre, and supply logistics • Perform radiation risk assessment on the facility • Determine the: ○ Radiation shielding requirements taking into consideration: – Room layout – Types of treatments to be performed – Projected patient load – Types and activities of the sources – Occupancy factors ○ Appropriate shielding materials for: – Door/entrance – Walls – Ceiling – Floor ○ Required thickness for the shielding structures ○ Radiation warning signs and signals ○ Ancillary and accessory safety equipment, including: – Radiation monitoring and alarm system – Door interlock – Closed circuit television ○ Safety interlock system • Calculate the radiation dose levels for: ○ Areas of interest ○ Staff ○ Other personnel • Advise on shielding design for a new or modified building • Conduct radiation survey and monitoring • Assess results, draw conclusion on the safe integrity of the treatment room and recommend course of action • Prepare reports and documentation
	Module 2. Radiation Safety and Protection
	Sub-module 2.6: Protection against medical exposure, occupational and public exposure
Objective	To develop key skills to organize provisions required for protection against medical exposure, occupational and public exposure
Competencies addressed	Knowledge and skills required to provide protection in relation to medical, occupational and public exposure
Recommended Items of Training	• Demonstrate familiarity with the specific application of radiation protection principles to medical, occupational and public exposure such as ○ Responsibilities ○ Justification ○ Optimization ○ ALARA principle

	• Understand methods to minimise dose to sites of risk such as o Foetus o Gonads o Lens o Spinal cord o Pacemaker • Perform calibration checks by o using an internationally accepted code of practice for external beam radiotherapy and for source strength determination o performing cross-checks of dose calculations • Compile relevant information given to the workers about their obligations and responsibilities for their own protection and the protection of others • Demonstrate a knowledge of all controlled areas in the department • Demonstrate an understanding of principles and practice for personal dosimeters o exposure assessment o monitoring period and frequency of reading o rules for returning and changing o rules for damage or if lost o record keeping • Oversee a personal dosimetry system. • Perform calculations for dose or exposure from beta particles and gamma sources. • Perform radiation protection area surveys surrounding radiation facilities
	Module 2. Radiation Safety and Protection
	Sub-module 2.7: Emergency Situations
Objective	To develop key skills to reach correct decisions in case of emergencies
Competency addressed	Ability to reach correct decisions in emergency situations.
Recommended Items of Training	• Investigate risk factors of radiation • Discuss radiation emergency plans o responsibilities o for each type of sealed sources o for any other credible radiation emergency which could arise in the local radiation oncology department o availability of equipment and tools • Carry out a formal risk assessment of a procedure • Plan and practice contingency measures, e.g. equipment malfunction, lost source, spill • Discuss decontamination procedures after a spill of liquid radionuclide • Be familiar with response procedures in the event of unnecessary dose to one or more individuals • Be familiar with response procedures in the event of machine malfunction, sealed source loss or misuse, unsealed source loss, misuse or spillage.
	Module 2. Radiation Safety and Protection

	Sub-module 2.8: Radiation Safety in Brachytherapy
Objective	Training on safe handling and use of brachytherapy sources.
Competency Addressed	Ability to perform the role of a radiation safety officer or source custodian in brachytherapy and to take appropriate safety and quality control procedures in brachytherapy treatment
Recommended Items Of Training	• Demonstrate an understanding of: • Principles and practice of radiation safety and protection in brachytherapy under normal and emergency situations • Local legislative requirements and international recommendations on quality and safety standards of brachytherapy equipment and procedures • Potential hazards and risks in brachytherapy • Safety requirements of: ◦ Legislation ◦ Guidelines/code of practice • Functionality and properties of radiation monitoring and protection equipment/tools • Conduct radiation risk assessment • Design: • A system of radiation protection for protection of: ◦ Staff ◦ Patient ◦ Other personnel • A safety system for radiation sources, covering: ◦ Storage security and safety ◦ Source inventory system ◦ A logging system for tracking source movement, including: • Delivery • Storage • Release for clinical application • Disposal ◦ Transportation • Local radiation safety rules, instructions, and operational procedures/guidelines • Radiation emergency procedures, including: ◦ Fire ◦ Brachytherapy equipment malfunction ◦ Loss of radioactive source • Perform: • Radiation monitoring/surveys of: ◦ Rooms ◦ Staff ◦ Patients • Regular source inventory check • Leakage test of sources • Testing on integrity of the: ◦ Treatment interlocks of afterloading equipment ◦ Area radiation monitoring and warning systems • Supervise/monitor and record the transfer of sources

	• Advice on: • Compliance with legislative requirements, including: ° Licence application • Safety and protection measures • Proper use of protective equipment and handling tools • Report of incident involving radiation o Prepare record and documentation
	Module 2. Radiation Safety and Protection
	Sub-module 2.9: Radiation Protection Design of Brachytherapy Treatment Rooms
Objective	Training on radiation shielding design of brachytherapy treatment room.
Competency Addressed in this Sub-module	Conduct of radiation risk assessment, design of room and source shielding in brachytherapy treatment facilities. Radiation survey and monitoring
Recommended Items Of Training	• Demonstrate an understanding on the: • Local legislative requirements on radiation safety and protection • International standards and recommendations • Nature and types of the treatment services to be provided • Types and strengths of the radioactive sources to be used • Nature of equipment to be installed • Projected patient load • Room layout requirements taking into consideration the requirements for sterility, patient flow, work flow, staff manoeuvre, and supply logistics • Perform radiation risk assessment on the facility • Determine the: • Radiation shielding requirements taking into consideration: ° Room layout ° Types of treatments to be performed ° Projected patient load ° Types and activities of the sources ° Occupancy factors • Appropriate shielding materials for: ° Door/entrance ° Walls ° Ceiling ° Floor • Required thickness for the shielding structures • Radiation warning signs and signals • Ancillary and accessory safety equipment, including: ° Radiation monitoring and alarm system ° Door interlock ° Closed circuit television • Safety interlock system • Calculate the radiation dose levels for: • Areas of interest • Staff

	• Other personnel • Conduct radiation survey and monitoring • Assess results, draw conclusion on the safe integrity of the treatment room and recommend course of action • Prepare reports and documentation

	MODULE 3. RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY
Objectives	To develop the skills and expertise required in radiation dosimetry for external beam therapy.
Competencies Addressed in this Module	• Capability in the understanding and use of ionisation chambers for relative and absolute determination of absorbed dose to water in radiotherapy beams. • Capable to perform dose measurements in radiotherapy beams using a range of dosimeters. • Capable to perform absorbed dose determination in external beam radiotherapy • Capable to perform relative dose measurements in external beam radiotherapy. • To be able to perform and analyse dose verification measurements in a • Able to monitor the accuracy of dose planned and delivered to Individual patients, patient groups, in standard treatment techniques and in special or new treatment techniques. • Ability to manage a QA programme for all dosimetry equipment
Time commitment	5-10% of the entire programme
Pre-requisite Knowledge	[1] PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapters 2, 3, 6, 8, 9
Sub-modules	3.1 Dosimetry Operations using Ionization Chambers 3.2 Dosimetry Operations using Other Methods 3.3 Absolute Absorbed Dose Measurements 3.4 Relative Dose Measurements 3.5 Patient Dose Verification 3.6 In-vivo Dosimetry 3.7 QA in Dosimetry
Core Reading List	INSTITUTE OF PHYSICS AND ENGINEERING IN MEDICINE AND BIOLOGY, The IPEMB code of practice for the determination of absorbed dose for x-rays below 300 kV generating potential (0 035 mm Al - 4 mm Cu; 10 - 300 kV generating potential), Phys. Med. Biol. **41** (1996) 2605-2625. INTERNATIONAL ATOMIC ENERGY AGENCY, Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water Technical Reports Series No. 398, IAEA, Vienna (2000). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Fundamental Quantities and Units for Ionizing Radiation, ICRU Rep. 60, Bethesda, MD (1998). INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Guide to the expression of uncertainty in measurement, 2nd ed. [Published by ISO in the name of BIPM, IEC, IFCC, IUPAC, IUPAP and OIML], ISO, Geneva (1995). PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A

	Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing, Madison WI, (1999).
Supplementary Reading List	ATTIX, F.H., Introduction to Radiological Physics and Radiation Dosimetry, John Wiley & Sons, New York (1986). INTERNATIONAL ATOMIC ENERGY AGENCY, Absorbed Dose Determination in Photon and Electron Beams: An International Code of Practice, Technical Reports Series No. 277, IAEA, Vienna (1987). INTERNATIONAL ATOMIC ENERGY AGENCY, The Use of Plane-parallel Chambers in High-energy Electron and Photon Beams: An International Code of Practice, Technical Reports Series No. 381, IAEA, Vienna (1997). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Tissue Substitutes in Radiation Dosimetry and Measurement, ICRU Rep. 44, Bethesda, MD (1989). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Dosimetry of High-Energy Photon Beams Based on Standards of Absorbed Dose to Water, ICRU Rep. 64, Bethesda, MD (2001). JOHNS, H.E., CUNNINGHAM, J.R., The Physics of Radiology, 4th edn, Thomas, Springfield (1983). KATHREN, R.L., Radiation Protection, Medical Physics Handbooks 16, Adam Hilger (1985). KHAN, F.M., The Physics of Radiation Therapy, 2nd edn, Lippincott, Williams & Wilkins (2003). KLEVENHAGEN, S.C., Physics and Dosimetry of Therapy Electron Beams, Medical Physics Publishing (1993). METCALFE, P., KRON, HOBAN, P., The Physics of Radiotherapy X-rays from Linear Accelerators, Medical Physics Publishing, Madison, WI (1997). WILLIAMS, J.R., THWAITES, D.I., (Eds), Radiotherapy Physics in Practice, 2nd edn., Oxford University Press, (2000). Manual for Beam Data Acquisition System Manuals supplied for all the electrometers and ionization chambers in the department Manuals for relevant radiation dosimetry equipment
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.1: Dosimetry Operations Using Ionization Chambers
Objective	• To develop the capability in the understanding and use of ionisation chambers for the determination of absorbed dose to water in radiation fields.
Competency addressed	Capability in the understanding and use of ionisation chambers for relative and absolute determination of absorbed dose to water in radiotherapy beams.
Recommended	• Demonstrate understanding of the following:

Items of Training	• Selection criteria for type of ionization chamber • The quantity and unit to be measured • Influence effects on the measured quantity (air density, recombination, polarity, warm-up, stem effects, leakage, humidity) • Correction factors for: o influence effects o radiation quality o Perturbation effects such as caused by the chamber cavity, chamber wall, central electrode, or by the replacement of medium by the chamber • Perform dose measurements with a range of ionization chambers to demonstrate understanding and correct application of the characteristics given above.
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.2: Dosimetry Operations Using Methods Other Than Ionization Chambers
Objective	To develop capability in the appropriate use of a range of dosimeters for dose measurements in radiotherapy beams.
Competency addressed	Capable to perform dose measurements in radiotherapy beams using a range of dosimeters.
Recommended Items of Training	• Demonstrate an understanding of the advantages and disadvantages of using particular detectors for absolute and relative dosimetry measurements. • Perform measurements with TLDs and demonstrate an understanding of aspects such as: o Commonly available TLDs (shapes, sizes and materials). o Common examples of TLD measurements: eye, TBI etc. o TLD measurements: preparation, precautions etc. o Basic structure and function of the photomultiplier tube. o QA in TLD measurements • Perform measurements with Solid State dosimeters and demonstrate an understanding of aspects such as: o Design of diodes, photon/electron diodes, shielding, pre-irradiation, energy dependence. o Typical bias voltages and output currents. • Perform measurements with films including radiographic and radiochromic films, and demonstrate an understanding of aspects such as: o Basic structure and function of film types. o Basic structure and function of a film processor. o Basic structure and function of a film densitometer/scanner. o Perform a calibration of film in terms of absorbed dose o QA for film dosimetry.
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.3: Absolute Absorbed Dose Measurements
Objective	To use ionisation chambers to perform absolute determination of absorbed dose to water under reference conditions in radiotherapy beams following

	a standard dosimetry protocol.
Competencies addressed	Capable to perform absorbed dose determination in external beam radiotherapy.
Recommended Items of Training	• Demonstrate a familiarity with the use of the IAEA TRS398 Code of Practice (or another accepted protocol) • Explain differences to other protocols • Determine the radiation quality for different types of radiation (depending on availability) • Perform a determination of absorbed dose under reference conditions using the TRS 398 Code of Practice and associated spreadsheets as provided by the IAEA for different types of beams (depending on availability) • Perform a cross calibration procedure in particular for electrons. • Analyse the uncertainty of dose calibration.
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.4: Relative Dose Measurements
Objective	To develop the expertise in the appropriate use of a range of dosimetry systems and phantom materials for the measurement of relative dose and dose distributions in radiotherapy beams.
Competencies addressed	Capable to perform relative dose measurements in external beam radiotherapy.
Recommended Items of Training	**Dosimeter related issues** • Demonstrate an understanding of the appropriate use of dosimeters for relative dose measurements • Demonstrate an understanding of factors influencing a dose measurement und non-reference conditions **Phantom related issues** • Demonstrate an understanding of the requirements on dosimeters and phantoms for measurements in phantoms • Explain correction factors required for non water-equivalent phantom materials (differential for photons and electrons) **Auxiliary related issues** • Demonstrate familiarity with the operation of a water phantom system including knowledge of statistical analysis, correction facilities, hard copy print out etc that may be provided with the system • Demonstrate an understanding of the design criteria and purpose of common dosimetric accessories such as intercomparison jigs or blocks, calibration blocks etc. **TPS related issues** • Determine at least the following items in a water phantom: o Percentage depth dose

	○ Beam profiles ○ TAR/TPR/TMR ○ scatter factors (collimator scatter factor, phantom scatter factor) • Determine the following items (if used) in a solid phantom (using different dosimetry equipment): ○ Real wedge transmission factor ○ Total scatter factors ○ Collimator scatter factors ○ Compensator factor ○ Electron cutout factor ○ Tray transmission factor • Perform measurements with film (if available) in a solid phantom. • Demonstrate an understanding of the uncertainties involved in the measurements. • Analyse the uncertainty of data.
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.5: Patient Dose Verification
Objective	To develop the expertise to perform a dose verification procedure
Competency addressed	Ability to perform and analyse dose verification measurements in a phantom in order to decide on acceptance of a treatment plan.
Recommended Items of Training	• Participate in an existing programme or design a new programme for patient dose verification. • Transfer the beam configuration of a specific patient treatment plan to an appropriate phantom, measure absolute dose at selected points of interest and compare results to calculated doses. • Understand and use quantitative methods to describe the degree of compliance by using tolerance and/or action levels, e.g. the Gamma-Index method. • List the decision making process behind acceptance and rejection of a treatment plan.
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub-module 3.6: In-vivo Dosimetry
Objective	To be able to understand, participate and improve/implement an in-vivo dosimetry programme for individual patients, patient groups, standard treatment techniques, and special or new treatment techniques.
Competency addressed	Ability to monitor the accuracy of dose planned and delivered to Individual patients, patient groups, in standard treatment techniques and in special or new treatment techniques.
Recommended Items of Training	• Review and improve/implement an in-vivo dosimetry programme in line with national and international best practice. • Undertake a literature review on the advantages and disadvantages of an in-vivo dosimetry programme and choice of dosimeter. • Demonstrate an understanding of advantages and disadvantages of different methods • Perform in-vivo dosimetry measurements (including writing a case

	study report) for such examples as: o lens of the eye o in field measurements for ▪ orthovoltage x-ray beams ▪ megavoltage x-ray beams ▪ electron beams
	Module 3. Radiation Dosimetry for External Beam Therapy
	Sub Module 3.7: QA in Dosimetry
Objective	To be able to understand and follow recommendations for quality assurance of dosimetry equipment in a radiotherapy department.
Competencies addressed	Ability to manage a QA programme for all dosimetry equipment
Recommended Items of Training	• Demonstrate a familiarity with QA recommendations for radiation dosimetry equipment such as: o Electrometer o thermometer o barometer o water phantom o TLD system o Film densitometer/scanner • Perform acceptance, commissioning and QC checks for dosimetry equipment (including ionization chambers, TLD, solid state detectors, film) according to a QA programme. • Review and improve/implement a QA programme for dosimetry equipment. • Check the traceability to a PSDL for a calibration factor used for absolute dose determination • Demonstrate a familiarity with the IAEA TLD audit system • Review the requirements for quality assurance of an in-vivo dosimetry programme • Demonstrate a familiarity with the method to express uncertainties in dose measurement.

	MODULE 4: RADIATION THERAPY – EXTERNAL BEAM
Objective	**To provide residents with knowledge and competencies relating to external beam therapy.**
Competencies Addressed in this Module	• Demonstrate an understanding of the physical principles and range of equipment in Radiation Oncology for treatment and imaging. • To be able to prepare specifications and advice for new equipment in association with other professional and technical staff. • To be able to design and perform acceptance testing procedures for: o Orthovoltage therapy unit o Megavoltage therapy unit o Simulator/Simulator-CT and o CT scanner/CT-simulator. • To be able to design and perform commissioning procedures for : o Orthovoltage therapy unit. o Megavoltage therapy unit. o Simulator/Simulator-CT and o CT scanner/CT-simulator • To be able to design and perform quality control (to provide ongoing monitoring and assessment of acceptable performance) for: o Orthovoltage therapy unit o Megavoltage therapy unit o Simulator/Simulator-CT and o CT scanner/CT-simulator • To be able to prepare operational procedures for the use of external beam equipment. • Demonstrate an understanding of the purpose, advantages and challenges of a range of beam modifiers and treatment techniques in modern radiotherapy. • Demonstrate an understanding of the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localisation. • Perform measurements to verify dose delivery accuracy for external beam treatment techniques.
Time commitment	15 - 20% of the entire programme
Pre-requisite knowledge	PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapters 5, 10, 12, 15.
Sub-modules	4.1 Treatment and Imaging Equipment 4.2 Specification and Acquisition of New Equipment

	4.3 Quality Assurance of External Beam Equipment I – Acceptance Testing 4.4 Quality Assurance of External Beam Equipment II – Commissioning 4.5 Quality Assurance of External Beam Equipment III – Quality Control 4.6 Operational Procedures for External Beam Equipment 4.7 Treatment Techniques 4.8 Patient Positioning and Treatment Verification.
Core Reading List	INTERNATIONAL ATOMIC ENERGY AGENCY, Setting up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety, IAEA, Vienna (2008). http://www-pub.iaea.org/MTCD/documents/PDF/pub1296_web.pdf. VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing, Madison WI, (1999). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology, Vol. 2, Medical Physics Publishing, Madison, WI, (2005). WILLIAMS, J.R., THWAITES, D.I., (Eds), Radiotherapy Physics in Practice, 2nd edn., Oxford University Press, (2000).
Supplementary Reading List	AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Comprehensive QA for Radiation Oncology, AAPM Rep. 46, New York (1994). http://www.aapm.org/pubs/reports/RPT_46.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, AAPM Report 47, AAPM Code of Practice for Radiotherapy Accelerators, Medical Physics **21** 7 (1994). AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Stereotactic Radio surgery Radiation Therapy Committee Task Group #42, AAPM Rep. 54, New York (1995). http://www.aapm.org/pubs/reports/rpt_54.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Basic Applications of Multileaf Collimators Radiation Therapy Committee Task Group #50, AAPM Rep. 72, New York (2001). http://www.aapm.org/pubs/reports/rpt_72.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Clinical use of electronic portal imaging AAPM Rep. 74, New York (2001). http://www.aapm.org/pubs/reports/rpt_74.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Guidance document on delivery, treatment planning, and clinical implementation of IMRT, AAPM Rep. 82, New York (2003) 27. http://www.aapm.org/pubs/reports/RPT_82.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Diode in Vivo Dosimetry for Patients Receiving External Beam Radiation Therapy, Radiation Therapy Committee Task Group #62, AAPM Rep. 87, New York (2005). http://www.aapm.org/pubs/reports/RPT_87.pdf. BOMFORD, C.K., KUNKLER, I.H., Walter and Miller's Textbook of Radiotherapy, 6th edn, Churchill Livingstone/Elsevier Science Ltd, Edinburgh (2002).

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	Module 4: Radiation Therapy – External Beam
	Sub-module 4.1: Treatment and Imaging Equipment
Objective	To understand the operation of the main items of equipment used in Radiation Oncology for treatment and imaging.
Competency	An understanding of the physical principles and range of equipment in

Addressed	Radiation Oncology for treatment and imaging.
Recommended Items Of Training	• Demonstrate an understanding of the operation of: ◦ orthovoltage x-ray therapy unit ◦ Co-60 unit ◦ linear accelerators and any ancillary equipment (e.g. EPID, mMLC) ◦ simulators and any ancillary equipment ◦ CT scanner ◦ Other imaging modalities used (e.g. MRI, ultrasound) ◦ treatment planning system ◦ record and verification system ◦ Image transfer network
	Module 4: Radiation Therapy – External Beam
	Sub-module 4.2: Specifications and Acquisition of New Equipment
Objective	To develop the expertise to prepare specifications for new therapy and imaging equipment and to advise on equipment acquisition, as part of a multidisciplinary team.
Competency Addressed	To be able to prepare specifications and advice for new equipment in association with other professional and technical staff.
Recommended Items of Training	• Demonstrate an understanding on process involved in equipment requisition and acquisition • Review and report on department needs on: ◦ Patient load ◦ Equipment technology ◦ Functionality ◦ Performance ◦ Compatibility ◦ Training ◦ Maintenance service ◦ Building and building services ◦ Delivery and installation • Analyse local and external restrictions placed on new equipment acquisition. • Compile and compare local legislative requirements and international recommendations on safety of equipment. • Perform: ◦ Market research on equipment technology ◦ Technology assessment ◦ Review of procurement documentation • Participate in multidisciplinary meetings with professionals and technical staff to decide on the department's requirements for new equipment.

	• Prepare/perform in collaboration with other professionals and technical staff: ° Tender specification ° Tender evaluation ° Tender recommendation
	Module 4: Radiation Therapy – External beam
	Sub-module 4.3: Quality Assurance of External Beam Equipment – Acceptance Testing
Objective	**To develop the experience to perform and design acceptance testing procedures for orthovoltage and megavoltage therapy units and simulators.**
Competencies Addressed	• To be able to design and perform acceptance testing procedures for an orthovoltage therapy unit. • To be able to design and perform acceptance testing procedures for a megavoltage therapy unit. • To be able to design and perform acceptance testing procedures for a. ° Simulator/Simulator-CT and/or ° CT scanner/CT-simulator
Recommended Items of Training	• Demonstrate an understanding of the: ° concept and principles of an acceptance testing programme including: ▪ Safety aspects ▪ Mechanical aspects ▪ Dosimetry measurements ° methods, procedures and tools for acceptance testing of equipment and its accessories. • Assess the properties and characteristics of the equipment, including specification and functionality of equipment. • Design methods and test procedures/protocols and worksheets for an acceptance testing programme, including oFunctionality oBeam characteristics oIntegrity of accessories oNetwork integration and data transfer oSafety features • Develop and prepare test and measurement protocols and worksheets • Participate in acceptance testing of an oorthovoltage therapy unit omegavoltage therapy unit otreatment simulator (simulator/simulator CT, CT/CT-simulator). • Prepare and/or review acceptance test report and recommendations
	Radiation Therapy – External Beam
	Sub-module 4.4: Quality Assurance of External Beam Equipment II – Commissioning

Objective	To develop the experience to perform and design commissioning procedures for orthovoltage and megavoltage therapy units and treatment simulators.

Competencies Addressed	• Ability to design and perform commissioning procedures for an orthovoltage therapy unit.
	• Ability to design and perform commissioning procedures for a megavoltage therapy unit.
	• Ability to design and perform commissioning procedures for a.
	  o Simulator/Simulator-CT and/or
	  o CT scanner/CT-simulator

Recommended Items of Training	• Review quality and legislative standards.
	• Demonstrate an understanding of the methods, procedures and tools for commissioning of equipment and its accessories.
	• Design methods, procedures and work programme for commissioning to prepare equipment for clinical application including:
	  o Prepare test and measurement protocols and worksheets including
	  • Safety aspects
	  • Mechanical aspects
	  • Dosimetry measurements
	  o Network integration and data transfer
	  o Scheduling of training
	• Participate in commissioning of an orthovoltage and megavoltage therapy unit (*refer to Dosimetry and External Beam Treatment Planning modules, modules 3 and 5, for related competencies*), including
	  o The acquisition of all radiation beam data required for treatment.
	  o Verifying the accuracy of treatment procedures.
	• Participate in commissioning of a treatment simulator (simulator/simulator-CT, CT/CT-simulator).
	• Prepare and/or review commissioning report and documentation including
	  ° Sources and magnitude of errors
	  ° Establishing baseline values for subsequent QC tests
	• Report on the progress of commissioning to a multidisciplinary team.

	Module 4. Radiation Therapy – External Beam
	Sub-module 4.5: Quality Assurance of External Beam Equipment III – QC
Objective	To design and perform a quality control programme for an orthovoltage and megavoltage therapy unit and treatment simulators.
Competencies Addressed	• Ability to design and perform quality control to provide ongoing monitoring and assessment of acceptable performance) for an orthovoltage therapy unit • Ability to design and perform quality control to provide ongoing monitoring and assessment of acceptable performance) for a megavoltage therapy unit • Ability to design and perform quality control to provide ongoing

	monitoring and assessment of acceptable performance) for a. o Simulator/Simulator-CT and/or o CT scanner/CT-simulator
Recommended Items of Training	• Demonstrate an understanding of the role of a QC programme. • Compare and contrast of local QC programme with international guidelines and best practice, specifying issues such as: ° Parameters to be tested and the tests to be performed; ° Specific equipment to be used to perform the tests; ° Geometry of the tests; ° Frequency of the tests; ° Staff group or individual performing the tests, as well as the individual supervising and responsible for the standards of the tests and for actions that may be necessary if problems are identified; ° Expected results; ° Tolerance and action levels; ° Actions required when the tolerance levels are exceeded. • Design a QC programme including daily, weekly, monthly and annual checks for: ° Orthovoltage therapy unit ° Megavoltage therapy unit ° treatment simulator (simulator/simulator-CT and/or CT-simulator/CT). • Perform QC tests on orthovoltage unit, such as: ° Dose output checks ° Safety checks and interlocks ° Energy checks (HVL) ° Applicator factor checks ° Depth dose measurements • Perform weekly, monthly and annual QC checks on a megavoltage therapy unit such as o Weekly ▪ Safety checks ▪ Weekly x-ray dose output checks ▪ Weekly electron dose output checks ▪ Optical distance indicator ▪ Isocentre indicator checks including reticule ▪ Laser checks ▪ Light field checks including field sizes ▪ Jaw sag tests ▪ Couch movements ▪ Couch isocentric rotation o Monthly* ▪ Safety checks and interlocks ▪ Gantry and collimator angle indicators ▪ Full laser checks ▪ Isocentre indication ▪ Optical distance indicator ▪ Jaw symmetry ▪ X-ray depth dose constancy ▪ X-ray flatness and symmetry ▪ X-ray field size checks ▪ Electron depth dose curves

	▪ Electron profile flatness and symmetry o Annual* ▪ Safety checks ▪ Mechanical isocentre determination ▪ Radiation isocentre determination ▪ Radiation/Mechanical isocentre coincidences ▪ Optical systems ▪ Couch mechanical tests ▪ X-ray beam depth dose curves ▪ X-ray beam profiles ▪ Fixed wedge depth dose curves ▪ Fixed wedge profiles ▪ Fixed wedge transmission factors ▪ Collimator scatter factor determination ▪ Phantom scatter factor determination ▪ Block transmission checks ▪ MLC leaf QA checks ▪ MLC leaf calibrations ▪ Electron depth dose curves ▪ Electron output factors • Perform QC on ancillary equipment o Portal imaging o Record and verification system and related networking • Perform weekly, monthly and annual QC checks on a simulator/simulator-CT, such as: o Weekly* ▪ Optical distance indicator ▪ Isocentre indicator checks including reticule, ▪ Laser checks, ▪ Light field checks including field sizes o Monthly* ▪ Safety checks, ▪ Gantry and collimator angle indicators ▪ Full laser checks ▪ Isocentre indication ▪ Optical distance indicator ▪ Accuracy of the delineators ▪ Beam quality checks o Annual* ▪ Isocentre determination ▪ Optical systems ▪ Couch tests ▪ Delineator calibrations ▪ Beam kV tests ▪ Beam mA tests ▪ Participate in full annual QA programme for simulator • Perform QC tests on CT scanner, such as: o Mechanical and optical checks o Safety o Test of CT number to electron density data • After maintenance to external beam equipment, perform subsequent verification to ensure accurate delivery of radiation dose to patients. * Or as required for local conditions

	Module 4. Radiation Therapy – External Beam
	Sub-module 4.6: Operational procedures for external beam equipment
Objective	To develop operational procedures for external beam equipment.
Competencies Addressed	To be able to prepare operational procedures for the use of external beam equipment.
Recommended Items of Training	• Compare local operational procedures for all external beam equipment with the manufacturer's operational manual, information compiled during commissioning and relevant safety standards. • Write operational procedures for external beam equipment based on the manufacturer's operational manual, information compiled during commissioning and relevant safety standards. • Conduct tutorials for operators of equipment based on written documentation to ensure technical and safety instructions and equipment limitations are understood. • Translate examples of existing operating instructions into local language.
	Module 4. Radiation Therapy – External Beam
	Sub-module 4.7: Treatment Techniques
Objective	To develop an understanding and experience a range of external beam treatment techniques.
Competencies Addressed	Demonstrate an understanding of the purpose, advantages and challenges of a range of beam modifiers and external beam treatment techniques in modern radiotherapy.
Recommended Items of Training	• Demonstrate an understanding of and observe the differences between fixed source-to-surface (SSD) distance and isocentric treatment techniques • Demonstrate an understanding of the use of certain beam combinations for different treatment sites and the use of weighting and normalisation. • Demonstrate an understanding of the advantages of and observe the use of the following beam modifiers: ° Beam shaping devices ° Wedge filters ° Bolus ° Compensators • Demonstrate an understanding of the advantages of and observe the following treatment techniques: ° field matching of various radiation beam types and energies ° rotational ° 3D conformal radiotherapy ° non-coplanar beams ° IMRT methods: static, dynamic ° TBI

	° TSEI ° IGRT ° Radiosurgery ° Stereotactic radiotherapy • Demonstrate an understanding of the advantages of advanced treatment techniques such as: ° Intraoperative radiotherapy ° Particle beam treatments ° Tomotherapy • Describe the methods (if possible) and difficulties of field matching and re-treatment with advanced treatment techniques.
	Module 4. Radiation Therapy – External Beam
	Sub-module 4.8: Patient Positioning and Treatment Verification
Objective	To understand methods of monitoring and controlling sources and levels of uncertainty in geometry and dose during patient treatment delivery.
Competencies Addressed	• Demonstrate an understanding of the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localisation. • Perform measurements to verify dose delivery accuracy for external beam treatment techniques.
Recommended Items of Training	• Demonstrate an understanding of the purpose of and observe: o Basic patient set-up and movement tracking systems o The manufacturing and use of immobilisation devices o An immobilised patient from mould room to treatment machine o Imaging systems for patient positioning from simulation to treatment verification o Simulator to verify plans before treatment o Various methods of port film/EPI evaluation to assess patient positioning accuracy and precision. o Lasers from real/virtual simulation to treatment. o Verification of patient positioning and dose delivery with IMRT o Verification of patient positioning with non-coplanar fields o Patient set-up and delivery of stereotactic radiosurgery treatment. o Stereotactic and advanced immobilisation devices o Advanced patient set-up and movement tracking systems (e.g. IGRT, respiratory gating) • Demonstrate an understanding of uncertainties, tolerance and action levels of one or more treatment techniques listed above. • Use a record and verify system. • Perform a literature review on immobilisation for one treatment site. • Manufacture a patient immobilisation device. • Explain discrepancies between portal images, simulator verification images and DRRs. • Perform dose delivery verification of a patient's treatment plan utilising a phantom and an appropriate dosimeter for a: o Conventional treatment technique o IMRT.

	MODULE 5: EXTERNAL BEAM TREATMENT PLANNING
Objective	To provide physicists with the required knowledge and competency to perform radiotherapy treatment planning.
Competencies Addressed in this Module	• Capability to make budgetary requests and acquire, through a tendering process, a suitable treatment planning computer for external beam planning • Capability to perform acceptance testing of a radiotherapy treatment planning system (RTPS) • Capability to commission an RTPS • Capability to conduct quality control (QC) of a RTPS • Ability to perform the duties of a treatment planning computer system administrator • Ability to acquire and use patient image data for treatment planning. • Ability to estimate the uncertainties involved in the patient data acquired and to correct/accommodate such errors in treatment planning • Performance of manual treatment planning and dose calculation • Use of treatment planning computers for treatment planning and dose optimisation evaluation • Planning of new treatment techniques • Performance of QC of individual treatment plans
Expected time commitment	• 20 - 30% of the entire programme
Pre-requisite Knowledge	PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapters 5 - 12.
Sub-modules	5.1 Procurement of a treatment planning computer 5.2 Quality Assurance in treatment planning 5.3 Planning computer system administration. 5.4 Acquisition of patient anatomical information. 5.5 Treatment planning
Core Reading List	INTERNATIONAL ATOMIC ENERGY AGENCY, Commissioning and QA of Computerised Treatment Planning Systems for Radiation Treatment of Cancer, Technical Reports Series No. 430, IAEA, Vienna (2004). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Quantities and Units in Radiation Protection Dosimetry, ICRU Rep. 51, Bethesda, MD (1993). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Prescribing, Recording, and Reporting Electron Beam Therapy, ICRU Rep. 71, Bethesda, MD (2004). KHAN, F.M., The Physics of Radiation Therapy, 2nd edn, Lippincott, Williams & Wilkins (2003). MOULD, R.F., Radiotherapy Treatment Planning, 2nd edn, Institute of Physics Publishing (1985).
Supplementary Reading List	AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Comprehensive QA for Radiation Oncology, AAPM Rep. 46, New York (1994). http://www.aapm.org/pubs/reports/RPT_46.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Stereotactic

	Radiosurgery Radiation Therapy Committee Task Group #42, AAPM Rep. 54, New York (1995). http://www.aapm.org/pubs/reports/rpt_54.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Quality Assurance for Clinical Radiotherapy Treatment Planning, AAPM Rep. 62, New York (1998). http://www.aapm.org/pubs/reports/rpt_62.PDF. BENTEL, G.C., Radiation Therapy Planning, 2nd edn, McGraw-Hill (1996). BENTEL, G.C., NELSON, C.E., NOELL, K.T., Treatment Planning and Dose Calculations in Radiation Oncology, 4th edn, Pergamon (1989). BRITISH INSTITUTE OF RADIOLOGY (BJR), Central axis depth dose data for use in Radiotherapy, The British Institute of Radiology Rep. Brit. J. Radiol. Supplement no. 25, London (1996). DOBBS, J., BARRETT, A., ASH, D., Practical Radiotherapy Planning- Royal Marsden Hospital Practice, 2nd edn, Arnold (1992). GIBBON, J.P., (Ed.) Monitor Unit Calculations for External Photon & Electron Beams, Advanced Medical Publishing, (2000). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Use of computers in external beam radiotherapy procedures with high-energy photons and electrons, ICRU, Bethesda, MD Rep. 42 (1988). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Prescribing, Recording and Reporting Photon Beam Therapy (Supplement to ICRU Report 50), ICRU Rep. 62, Bethesda, MD (1999). KLEVENHAGEN, S.C., Physics of Electron Beam Therapy, Adam Hilger (1985). MEMORIAL SLOAN-KETTERING CANCER CENTRE, A Practical Guide to Intensity-Modulated Radiation Therapy, Medical Physics Publishing (2003). PURDY, J.A., STACKSCHALL, G., (Eds), A Practical Guide to 3-D Planning and Conformal Radiation Therapy, Advanced Medical Publishing, (1999). SMITH, A.R., PURDY, J.A., Three-Dimensional Photon Treatment Planning, Int J Radiat Oncol Biol Phys **21** 1 (1991) 1–265. VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing, Madison WI, (1999). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology, Vol. 2, Medical Physics Publishing, Madison, WI, (2005).
	Module 5: External Beam Treatment Planning
	Sub-module 5.1: Procurement of treatment planning computer
Objective	To develop the competency necessary to acquire a treatment planning computer.
Competency Addressed	Capability to make budgetary requests and acquire, through a tendering process, a suitable treatment planning computer for external beam planning
Recommended Methods Of Training	• Demonstrate an understanding of the process involved in equipment requisition and acquisition • Review and report on department needs on: ° Equipment technology

	° Functionality ° Performance ° Compatibility ° Training ° Maintenance service ° Building and building services ° Delivery and installation • Perform: ° Market research on equipment technology ° Technology assessment ° Review of procurement documentation • Submit project proposal and budgetary request • Prepare/perform within a multidisciplinary team ° Tender specification ° Tender evaluation ° Tender recommendation
	Module 5: External Beam Treatment Planning
	Sub-module 5.2: Quality Assurance in Treatment Planning
Objective	To develop the ability and skill to design and implement the physical aspects of a QA programme for treatment planning.
Competencies Addressed in this Sub-module	• Capability to perform acceptance testing of a radiotherapy treatment planning system (RTPS) • Capability to commission an RTPS • Capability to conduct quality control (QC) of a RTPS
Recommended Items f Training	• Demonstrate an understanding of: ° The treatment planning process ° The potential sources and magnitude of errors associated with: ▪ Patient data ▪ Beam data ▪ Manual and computer dosimetry calculation algorithms ▪ Treatment planning equipment ° The operation, functionality, performance specification and inventory items of an RTPS ° Merits and limitations of the range of dose calculation algorithms ° The principles and design of a treatment planning QA programme • Design the protocols of a QA programme for a treatment planning computer based on the recommendations as specified in IAEA Technical Report Series No. 430 or an equivalent international recommendation as adopted by the department, including: ° Acceptance testing against equipment specification, including: ▪ Inventory check ▪ Functionality test of hardware and software ▪ Geometric and dosimetric accuracy ▪ Network integration and data transfer ° Commissioning for photon and electron beam planning, including: ▪ Configuration of: ➢ Computer system ➢ Patient demographic data ➢ Security and backup system

	➢ Treatment machine ➢ Beam data required, including transfer/input of measured beam data into computer system (see module 3 Radiation Dosimetry for External Beam Therapy for related items of training) ➢ Calculation parameters ➢ Treatment plan report ➢ Record and archival ➢ Calibration ➢ Display and output format ▪ Verification against measurements and/or independent methods of: ➢ Image registration and contouring tools ➢ CT density ➢ Beam data transferred from acquisition system ➢ Beam models in standard and extreme conditions ➢ Dosimetry calculations, including MU calculations ➢ Treatment plans, including: ▪ Dose ▪ Dose distribution ▪ DVH ▪ Anatomical geometry ▪ Beam geometry ▪ Inhomogeneity correction ➢ Plan output and transfer ° Quality control of: ▪ RTPS system ▪ Input and output devices ▪ Backup system ▪ Beam data ▪ Patient and image data ▪ Body and organ contouring ▪ Dose calculation tools ▪ Individual patient plan (refer to sub-module 5.5 Treatment Planning below) ▪ Computer network • Identify and recommend: ° QC test and measurement equipment required ° Tolerance limits and action levels for each QC test • Develop and prepare worksheets for the tests and measurements • Using the established protocols and worksheets, perform: o Acceptance testing o Commissioning o Quality control • Report any deviations or functional abnormalities and propose corrective actions • Review and update QA protocols and procedures on a regular basis • Prepare: ° Acceptance test report and recommendation ° Commissioning report ° QC report ° Planning data manual
	Module 5: External Beam Treatment Planning

	Sub-module 5.3: Planning computer system administration
Objective	To develop the ability and skill to assume the functions of a treatment planning computer system administrator.
Competency Addressed	Ability to perform the duties of a treatment planning computer system administrator
Recommended items of training	• Develop and implement the following guidelines, policies and administrative measures for a treatment planning computer system: ◦ System security ◦ Assign user rights ◦ Operational rules and guidelines ◦ Data protection ◦ Release of new or updated planning data for clinical use ◦ Release of new or upgraded computer hardware and software for clinical use ◦ Import and export of data • Perform: ◦ System and data backup ◦ system upgrades/updates • Manage/monitor: ◦ Software & hardware inventory ◦ System operation and application ◦ Training programme ◦ Data storage and archival ◦ Maintenance ◦ Upgrades/updates ◦ Operational and functional abnormalities • Identify and report any deviations or functional abnormalities and arrange for corrective measures/actions • Maintenance of: ◦ Planning data library and manuals ◦ Logbook and/or record for: ▪ Treatment plans ▪ Operational/functional incidents and/or abnormalities ▪ All upgrades and updates ▪ Maintenance
	Module 5; External Beam Treatment Planning
	Sub-module 5.4: Acquisition of patient data
Objective	To provide training on acquisition of patient data for treatment planning.
Competencies Addressed	• Ability to acquire and use patient image data for treatment planning. • Ability to estimate the uncertainties involved in the patient data acquired and to correct/accommodate such errors in treatment planning
Recommended Items Of Training	• Demonstrate an understanding of the following: ◦ Patient treatment set up and positioning procedures ◦ The purpose, importance and dosimetric considerations of patient immobilisation in external beam therapy ◦ Accuracy and limitations of immobilization devices

	◦ Mould making procedures ◦ Patient data required for treatment planning Methods for acquisition of patient data, including: ▪ Manual methods ▪ Simulator ▪ CT/CT-Simulator ▪ MRI ▪ PET/CT-PET Magnitude and sources of uncertainties involved in the: ▪ Image data ▪ Contouring of target volumes and critical tissue structures of interest Treatment margins needed for contouring the target volumes and organs at risk for a variety of treatment sites Application of the ICRU concepts in contouring: ▪ Target volumes ▪ Normal organs at risk ▪ Treatment margins • Transfer of patient image data to treatment planning systems • Perform image registration and contouring, including: ◦ Contouring of the treatment targets and organs of interest for a variety of treatment sites with: ▪ Radiographs ▪ CT images ▪ MR images ▪ Fused CT, MRI, and PET images ◦ Margins to compensate/accommodate inter-fraction and intra-fraction treatment errors. ◦ Image reconstruction ◦ 2-D and 3-D display of contoured body and tissue structures ◦ Generation of digital reconstruction radiograph (DRR) ◦ Identification of planning contours reference points for dose assessment and treatment set up • Provide supervision/support/advice on: ◦ patient immobilization and patient data acquisition procedures ◦ Acquisition and application of patient data for treatment planning ◦ Image transfer and registration ◦
	Module 5: External Beam Treatment Planning
	Sub-module 5.5: Treatment Planning
Objective	To be competent in external beam treatment planning and dose calculation.
Competencies Addressed	• Perform manual treatment planning and dose calculation • Use a treatment planning computers for treatment planning, dose optimisation and evaluation • Planning of new treatment techniques Perform QC of individual treatment plans

Recommended Items Of Training	• Demonstrate an understanding of the: ◦ Characteristics, applications, accuracy and limitations of the: ▪ External beam treatment machines ▪ Radiation beam data ▪ Patient image data ◦ Dose and dose fractionation schemes of a variety of treatments ◦ Principles, methods and procedures of: ▪ Treatment planning ▪ Dose calculation and optimization ▪ Treatment simulation ◦ Local medical legal requirements for record and documentation in radiotherapy. ◦ ICRU and the local systems of dose prescription, recording and reporting in external beam therapy. ◦ Content, format and patient identification system of the department dose prescription chart and treatment record for a variety of treatments and the level of compliance with ICRU recommendations. ◦ Content and format of department treatment plan for a variety of treatments and the level of compliance with ICRU recommendations. ◦ Tolerance dose of a variety of normal tissue structures and organs ◦ Criteria and procedures for accepting treatment plans of a variety of treatment sites ◦ Radiation beam arrangements for a variety of treatments ◦ Choice of beam modality and energy for clinical applications. ◦ Sources and magnitude of errors involved in manual and computer planning including dose calculation grid resolution. ◦ Effect and purpose of: ▪ Beam parameters on dose (e.g. field size, off axis, weighting, normalisation, FSD, energy, photon/electron) ▪ Beam modifiers (e.g. shielding, asymmetric jaws, MLC, wedges, compensators, bolus etc) on dose ▪ Tissue inhomogeneity and the shape of body contour on dose and correction methods ▪ Normalisation on isodose curves ▪ Errors and contrast media in patient image data on dose ▪ Organ and patient motions on dose and correction methods

	• Perform by manual and/or computer methods for a variety of treatments and patient set up conditions:
	  ◦ Dose distribution and MU or treatment time calculations for treatments using:
	  ▪ Orthovoltage X-ray beams
	  ▪ Megavoltage photon beams
	  ▪ Electron beams
	  ▪ Combination of photon and electron beams
	  ◦ Planning of treatments using:
	  ▪ Abutting fields
	  ▪ Arc therapy
	  ▪ Irregular fields
	  ▪ Wedged fields
	  ▪ Oblique incident beams
	  ▪ Tissue inhomogeneity correction
	  ▪ Beam modifiers/compensators
	  ▪ 3-D conformal radiotherapy
	  ▪ Total body irradiation
	  ▪ Total skin electron irradiation
	  ▪ Stereotactic techniques
	  ▪ Image guided radiotherapy techniques
	  ▪ Motion compensation radiotherapy techniques
	  ▪ Adaptive radiotherapy techniques
	  ◦ Forward and/or inverse planning and dose optimization of:
	  ▪ Intensity modulated radiotherapy
	• Demonstrate the use of a variety of tools in treatment planning, including:
	  ◦ Beam's eye view
	  ◦ 3D volumetric isodose displays
	  ◦ Digital reconstructed radiographs
	  ◦ Inverse dose planning and optimization based on physical dose and biological indices
	• Investigate for a variety of treatment sites, including prostate, lung and head and neck tumours, the sources and magnitude of:
	  ◦ Inter-fraction treatment errors
	  ◦ Intra-fraction treatment errors
	• Describe the effects and implications of treatment errors on dose distribution
	• Describe techniques that can be used to minimize inter-fraction and intra-fraction geometric errors for different treatment sites
	• Perform assessment and acceptance of treatment plans using a variety of evaluation tools, including:
	  ◦ Dose criteria for plan acceptance
	  ◦ Dose to the target volumes and critical organs
	  ◦ 3D volumetric dose distribution
	  ◦ Dose volume histograms
	  ◦ Dose conformity indices
	  ◦ Biological indices
	• Perform quality control of individual treatment plans, including:
	  ◦ Review/design:
	  • QC workflow, procedures and protocols for treatment plans and treatment charts
	  • Tolerance limits for interventional action for a range of plans

	◦ Use of independent dosimetry calculation systems for checking of treatment plans on dose/MU calculation ◦ Prepare appropriate QC or phantom plans for dosimetry verification by measurement or computer simulation of a variety of treatment plans, including: ▪ Intensity modulated radiotherapy ▪ Motion compensated radiotherapy ◦ Checking of the integrity of treatment data transfer to the treatment machine ◦ Evaluate in-vivo dosimetry measurement data against treatment planning calculations and interpret implications • Prepare documentation of individual treatment plans • Develop or support the development and commissioning of new planning techniques for existing or new treatments, including: ◦ Dosimetry evaluation and verification of new treatment plans by: ▪ Verifying treatment plans with phantom dosimetry measurement data ▪ Acquisition or design and construction of suitable dosimetry verification phantoms ▪ Design treatment delivery and QC procedures ◦ Introduction/implementation of new technology in treatment planning ◦ Provide training/demonstration to staff on new techniques/procedures • Supervise and support the physics aspects of treatment planning including: ◦ Continue improvement of the treatment planning process and work flow ◦ Preparation and implementation of the work procedures and protocols for treatment planning and simulation, record and documentation to meet clinical needs ◦ Advice/recommend on proper and efficient use and limitations of: ▪ Beam data and the dose calculation algorithms ▪ RTPS and accessory equipment ◦ Provide any planning data as required.

	MODULE 6: BRACHYTHERAPY
Objective	To provide the resident with the knowledge and competencies required in brachytherapy.
Competencies Addressed in this Module	• Capability to make budgetary requests and acquire, through a tendering process, suitable brachytherapy treatment and ancillary equipment • Capability to develop and perform acceptance testing of brachytherapy equipment • Capability to develop test procedures and protocols and to perform commissioning of brachytherapy equipment • Capability to design and develop the test procedures and protocols and to perform quality control (QC) on brachytherapy equipment • Capability to calibrate brachytherapy sources • Ability to supervise/advise on the use of imaging equipment to obtain/verify patient anatomical information and radiation source geometry for treatment planning/dose calculation • Capable of inputting patient and radiation source data to treatment planning system for planning • Ability to perform manual dose calculations in brachytherapy • Ability to use a treatment planning computer to generate an acceptable treatment plan • Ability to perform QC of individual treatment plans • Safe handling of brachytherapy sources and preparation of treatment applicators
Expected time commitment	• 10 – 15% of the entire programme
Pre-requisite Knowledge	PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). Chapters 2 and 13
Sub-modules	6.1 Procurement 6.2 Quality Assurance in Brachytherapy I - Acceptance testing 6.3 Quality Assurance in Brachytherapy II - Commissioning 6.4 Quality Assurance in Brachytherapy III - Quality control 6.5 Calibration of Brachytherapy sources 6.6 Image and source data for treatment planning 6.7 Treatment Planning 6.8 Source preparation
Core Reading List	BALTAS, D., SAKELLIOU, L., ZAMBOGLOU, N., The Physics of Modern Brachytherapy, Taylor and Francis (2006). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Dose and Volume Specification for Reporting Intracavity Therapy in Gynecology, ICRU Rep. 38, Bethesda, MD (1985). INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Dose and Volume Specification for Reporting Interstitial Therapy, ICRU Rep. 58, Bethesda, MD (1997). http://www.icru.org/index.php?option=com_content&task=view&id

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Supplementary Reading List	AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Specification of Brachytherapy Source Strength: Report of the AAPM Radiation Therapy Committee Task Group No. 32, AAPM Rep. 21, New York (1987). http://www.aapm.org/pubs/reports/RPT_21.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Remote Afterloading Technology: Report of the AAPM Radiation Therapy Committee Task Group No. 41, AAPM Rep. 41, New York (1993). http://www.aapm.org/pubs/reports/RPT_41.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Comprehensive QA for Radiation Oncology, AAPM Rep. 46, New York (1994). http://www.aapm.org/pubs/reports/RPT_46.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Dosimetry of Interstitial Brachytherapy Sources: Report of the AAPM Radiation Therapy Committee Task Group No. 43, AAPM Rep. 51, New York (1995). http://www.aapm.org/pubs/reports/RPT_51.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Code of practice for Brachytherapy Physics: Report of the AAPM Radiation Therapy Committee Task Group No. 56, AAPM Rep. 59, New York (1997). http://www.aapm.org/pubs/reports/RPT_59.pdf. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, High Dose Rate Brachytherapy Treatment Delivery: Report of the AAPM Radiation Therapy Committee Task Group No. 59, AAPM Rep. 61, New York (1998). http://www.aapm.org/pubs/reports/rpt_61.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Intravascular Brachytherapy Physics: Report of the AAPM Radiation Therapy Committee Task Group No. 60, AAPM Rep. 66, New York (1999). http://www.aapm.org/pubs/reports/rpt_66.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Permanent Prostate Seed Brachytherapy: Report of the AAPM Radiation Therapy Committee Task Group No. 64, AAPM Rep. 68, New York (1999). http://www.aapm.org/pubs/reports/rpt_68.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Update of AAPM Task Group 43 Report: A review AAPM protocol for brachytherapy dose calculations, AAPM Rep. 84, New York (2004). http://www.aapm.org/pubs/reports/rpt_84.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Recommendations of the AAPM regarding the impact of Implementing the 2004 Task Group 43 Report on Dose Specification for 103Pd and 125I Interstitial Brachytherapy, AAPM Rep. 89, New York (2005). http://www.aapm.org/pubs/reports/RPT_89.pdf. GODDEN, T.J., Physical Aspects of Brachytherapy, Adam Hilger (1988). HOSKIN, P., COYLE, C., (Eds), Radiotherapy in Practice-Brachytherapy, Oxford University Press, (2005). INSTITUTE OF PHYSICS AND ENGINEERING IN MEDICINE, The Design of Radiotherapy Treatment Room Facilities, IPEM Rep. 75,

	York (1997). JOSLIN, C.A., FLYNN, A., HALL, E.J., (Eds), Principles and Practice of Brachytherapy: Using Afterloading Systems, Arnold, (2001). THOMADSEN, B., Achieving Quality in Brachytherapy, Medical Science Series, Institute of Physics, Philadelphia (1999). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing, Madison WI, (1999).
	Module 6: Brachytherapy
	Sub-module 6.1: Procurement
Objective	To develop the competency on acquisition of brachytherapy equipment technology.
Competency Addressed	Capability to make budgetary requests and acquire, through a tendering process, suitable brachytherapy treatment and ancillary equipment
Suggested Methods Of Training	• Demonstrate an understanding on process involved in brachytherapy equipment requisition and acquisition • Review and report on department needs on: ◦ Equipment technology ◦ Functionality ◦ Performance ◦ Compatibility ◦ Training ◦ Maintenance service ◦ Building and building services ◦ Delivery and installation • Perform: ◦ Market research on brachytherapy equipment technology ◦ Technology assessment ◦ Review of procurement documentation • Submit project proposal and budgetary request • Prepare/perform ◦ Tender specification ◦ Tender evaluation ◦ Tender recommendation
	Module 6: Brachytherapy
	Sub-module 6.2: Quality Assurance in Brachytherapy I - Acceptance Testing
Objective	To develop competency on acceptance testing aspects of QA in brachytherapy.
Competency Addressed	Development and performance of test procedures and protocols for acceptance testing of brachytherapy equipment

Recommended Items Of Training	• Observe the installation of new equipment • Demonstrate an understanding of the: ◦ Concept and principles of a brachytherapy QA programme ◦ Local legislative requirements and international recommendations on safety of brachytherapy and remote afterloading equipment ◦ Properties and characteristics of the brachytherapy sources ◦ Specification, quality standard and operation characteristics of: • Brachytherapy sources • Treatment applicators • Afterloading brachytherapy equipment, including LDR, HDR, PDR ◦ Specification, functionality and dosimetry algorithm of brachytherapy treatment planning computer ◦ Sources and magnitude of errors associated with: • Manual and afterloading brachytherapy • Brachytherapy treatment planning computer • Dosimetric data of radioactive sources ◦ Methods and procedures for testing of: ▪ Remote afterloading brachytherapy equipment ▪ Brachytherapy source ▪ Treatment planning computer ◦ Use of test and measurement equipment required for acceptance testing ◦ Tolerance limits for each acceptance test • Design methods and test procedures/protocols and worksheets for a brachytherapy acceptance testing programme including: ◦ Inventory check ◦ Radioactive source, including: • Activity • Uniformity • Leakage • Physical integrity ◦ Afterloading equipment, including: • Functionalities of: ➢ Treatment planning computer ➢ Remote afterloading system • Integrity of treatment applicators and connectors • Source positioning accuracy • Dosimetric accuracy • Network integration and data transfer • Safety features • Develop and prepare test and measurement protocols and worksheets • Using established protocols and worksheets, perform acceptance testing of: ◦ Brachytherapy source ◦ Afterloading treatment equipment • Prepare and/or review acceptance test report and recommendations
	Module 6: Brachytherapy

	Sub-module 6.3: Quality Assurance in Brachytherapy II – Commissioning
Objectives	To provide training on commissioning of brachytherapy equipment and services.
Competencies Addressed in this sub-module	Development of test procedures and protocols for, and to perform, commissioning of brachytherapy equipment
Recommended Items Of Training	• Demonstrate an understanding of the: ◦ Operation and characteristics of brachytherapy services and equipment ◦ Performance assessment and testing of brachytherapy equipment and accessories ◦ Methods and procedures for commissioning of: ▪ Remote afterloading brachytherapy equipment ▪ Brachytherapy source ▪ Treatment planning computer ◦ Use of test and measurement equipment required for commissioning procedures • Design methods, procedures and work programme for commissioning of a remote afterloader system and treatment planning system, including: ◦ Configuration of the: ▪ Treatment planning computer system, including: ➢ Patient demographic data ➢ Security and backup system ➢ Brachytherapy source data ➢ Calculation parameters ➢ Treatment plan report format ➢ Record and archival ➢ Export of treatment data ▪ Remote afterloading treatment machine, including: ➢ Treatment control ➢ In-vivo dose monitoring system ➢ Security and backup system ➢ Import of treatment data ➢ Treatment record ◦ Verification against measurements and/or independent methods of: ▪ Treatment planning computer system, including: ➢ Image registration tools ➢ Integrity of input devices, including the digitizer ➢ Treatment planning, including: ▪ Dose ▪ Dose distribution ▪ DVH ▪ Source geometry ▪ Treatment time calculations ▪ Correction for: ◦ Decay ◦ Attenuation ▪ Treatment plan output and transfer

	➢ Afterloading treatment machine, including: ▪ Integrity of: ◦ Data transfer from treatment planning system ◦ Source transfer through the applicators and catheters ▪ Accuracy of: ◦ Source positioning ◦ Dwell time ▪ Multichannel applicator indexing system ▪ Treatment and safety features and interlock systems, including: ◦ Applicator, catheters, and connectors ◦ Treatment termination ◦ Door ◦ Radiation warning indication systems ◦ Video monitoring system ◦ Backup power system ◦ Automatic source retraction system • Prepare test and measurement protocols and worksheets • Perform commissioning of a: ◦ Remote afterloading treatment system ◦ Treatment planning computer system • Establishing baseline values for subsequent QC tests • Prepare and/or review commissioning report and documentation • Prepare/review operational procedures for treatment delivery
	Module 6: Brachytherapy
	Sub-module 6.4: Quality Assurance in Brachytherapy III - Quality Control
Objective	To provide training on quality control of brachytherapy equipment and sources
Competencies Addressed	Design, development and performance of test procedures and protocols for QC of brachytherapy equipment
Recommended Items Of Training	• Demonstrate an understanding of the: ◦ Operation characteristics and functionalities of brachytherapy equipment and sources ◦ Acceptance testing and commissioning of brachytherapy equipment and sources ◦ Sources and magnitude of errors in brachytherapy ◦ Methods and procedures for QC in brachytherapy ◦ Equipment required for QC measures ◦ Tolerance limits and action levels • Design a series of QC measures for brachytherapy covering: ◦ Quality control of: ▪ Treatment planning system ➢ Input and output devices ➢ Patient and image data ➢ Treatment dose and time calculation tools ➢ Computer network

	➢ Individual patient plan (refer to sub-module on Treatment Planning below) ▪ Integrity of radiation sources and their applicators ▪ Afterloading treatment system: ➢ Safety and interlock ➢ Power failure backup systems ➢ Integrity of: ◦ Treatment applicators ◦ Connectors ◦ Multichannel indexing system ◦ Source transfer ➢ Source position and dwell time accuracy ➢ Dose monitoring system ➢ Data transfer ▪ Treatment delivery, monitoring of: ➢ Applicators/source position ➢ Critical organ dose • Develop and prepare QC test and measurement protocols and worksheets • Perform QC on a: ◦ Remote afterloading treatment system ◦ Brachytherapy treatment planning system ◦ Brachytherapy source ◦ Brachytherapy treatment ◦ Dosimetry equipment • Prepare and/or review QC reports and documentation
	Module 6: Brachytherapy
	Sub-module 6.5: Calibration of Brachytherapy Sources
Objective	To provide training on measurement of the strength of brachytherapy sources.
Competency Addressed	Capability to calibrate brachytherapy sources.
Recommended Items Of Training	• Demonstrate an understanding of the: ◦ Dosimetry properties of brachytherapy sources ◦ Dosimetry protocols for calibration of brachytherapy sources, including the procedures and recommendations as given in IAEA TECDOC 1274 ◦ Properties and functionalities of the calibration equipment ◦ Uncertainties involved in determination of source strength by measurement and calculation methods • Design calibration worksheet • Calibrate the strength of a variety of brachytherapy sources using: ◦ Well-type ionisation chamber ◦ Thimble ionisation chamber • Compare source strength as given in vendor certificate with measurement. ◦ Demonstrate an understanding of remedial action if exceeds tolerance level.

	• Prepare: ◦ Source data for treatment planning ◦ Calibration report
	Module 6: Brachytherapy
	Sub-module 6.6: Acquisition of Image and Source Data for Treatment Planning
Objective	• To provide competency training on acquisition of patient image and source data for brachytherapy treatment planning.
Competencies Addressed	• Ability to supervise/advise on the use of imaging equipment to obtain/verify patient anatomical information and radiation source geometry for treatment planning/dose calculation • Capability of inputting patient and radiation source data to treatment planning system for planning
Recommended Items Of Training	• Demonstrate an understanding of the methods and procedures for: ◦ Localization and reconstruction of brachytherapy sources ◦ Acquisition of the relevant patient anatomical information and source (using dummy sources) geometry for treatment planning using: ▪ Radiotherapy treatment simulator ▪ Mobile C-arm X-ray unit ▪ CT scanner ▪ MRI ▪ Ultrasound scanner ◦ Measurement of dose and dose distribution of sources • Supervise/advice on the acquisition of patient image/data for treatment planning using X-ray, CT, and/or ultrasound for: ◦ Fractionated or permanent interstitial implant treatment for a variety of sites, including: ▪ Prostate ▪ Breast ▪ Tongue ◦ Intraluminal treatment, including: ▪ Bronchus ▪ Oesophagus ◦ Intracavitary treatment, including: ▪ Cervix ▪ Nasopharynx • Perform for a variety of treatment sites: ◦ Transfer of image data to the treatment planning system ◦ Reconstruction of source geometry at the treatment planning computer from: ▪ Orthogonal or stereo-shift X-ray film via digitizer ▪ CT, MR and/or ultrasound images ◦ Image registration using treatment planning system ◦ Contouring of treatment volume and critical structures of interest
	Module 6: Brachytherapy
	Sub-module 6.7: Treatment Planning

Objective	Provide training in brachytherapy treatment planning and dose calculation.
Competencies Addressed	• Ability to perform manual dose calculations in brachytherapy • Ability to use a treatment planning computer to generate an acceptable treatment plan • Ability to perform QC of individual treatment plans

Recommended Items Of Training	• Demonstrate an understanding of the:
	  ◦ Characteristics and merits of brachytherapy sources
	  ◦ Physical principles, methods and merits of:
	  ▪ Manual brachytherapy
	  ▪ Remote afterloading treatment techniques:
	  ➢ LDR
	  ➢ HDR
	  ➢ PDR
	  ◦ Radiobiological principles relevant to brachytherapy
	  ◦ Effects on dose of:
	  ▪ Source configuration
	  ▪ Inter-source heterogeneity
	  ▪ Source encapsulation
	  ▪ Treatment applicators
	  ◦ Principles and properties of a variety of source configuration and dosimetry systems for implant and intracavitary brachytherapy, including methods and algorithms used for:
	  ▪ Reconstruction of source geometry
	  ▪ Dose calculation
	  ▪ Treatment plan optimization
	  ◦ Patient and source data required for treatment planning
	  ◦ Limitations and uncertainties associated with manual and computer planning
	  ◦ ICRU system of dose specification
	  ◦ Local treatment protocols for a variety of sites:
	  ▪ Treatment techniques
	  ▪ Dose fractionation
	  ▪ Tolerance doses of organs of interest
	• Perform:
	  ◦ Source reconstruction with:
	  ▪ Radiographic images
	  ▪ Fluoroscopic images
	  ▪ CT images
	  ◦ Treatment planning and dose calculation by manual and computer methods of a variety of brachytherapy treatments, including:
	  ▪ Intra-cavitary implant, including manual and/or afterloading treatment of cervical cancer based on commonly used source configuration and dosimetry systems, including:
	  ➢ Manchester system
	  ➢ Paris System
	  ▪ Interstitial implant, including manual or afterloading treatment of:
	  ➢ Prostate implant based on commonly used dosimetry systems, including:
	  ▪ Manchester system
	  ▪ Paris system
	  ➢ Breast implant

	➢ Tongue implant ▪ Intra-luminal treatment, including treatment of: ➢ Bronchus ➢ Oesophagus ➢ Nasopharynx ▪ Intra-vascular treatment ▪ Surface mould/plaque, including treatment of: ➢ Eye ➢ Skin cancer ◦ Dose/plan optimization based on a combination of: ▪ Dose prescription/specification ▪ Source configuration/distribution ▪ Dwell time ◦ Calculation on radiobiological equivalence of treatment schemes, including: ▪ Protracted brachytherapy to fractionated treatments ▪ LDR and HDR brachytherapy ▪ Total dose of adding external beam radiotherapy • Prepare treatment chart/data • Quality control of individual patient treatment plans, including independent checking of: ◦ Integrity of input data ◦ Dose ◦ Dose distribution ◦ Treatment chart ◦ Integrity of treatment data transfer from planning computer to afterloading treatment unit
	Module 6: Brachytherapy
	Sub-module 6.8: Source Preparation
Objectives	To provide training on preparation of sealed radiation sources for brachytherapy.
Competency Addressed	Safe handling of brachytherapy sources and preparation of treatment applicators
Recommended Items Of Training	• Demonstrate an understanding of: ◦ Operation of a radiation source inventory and custody system ◦ System of work in a sealed source preparation room ◦ Principles and design of treatment applicators ◦ Procedures for safe handling and preparation of brachytherapy sources ◦ Source loading configurations for a variety of treatment protocols • Prepare for manual and/or afterloading treatments ◦ Treatment applicators and/or catheters for: ▪ Intra-cavitary treatments ▪ Intra-luminal treatments ▪ Interstitial treatments ▪ Surface treatments ◦ Implantation tools, such as treatment templates ◦ Brachytherapy sources for a variety of treatments, sources such as: ▪ Cobalt-60

	▪ Palladium-103 ▪ Iodine-125 ▪ Cesium-137 ▪ Iridium-192 ▪ Gold-198 • Supervise/advise on the cleaning and sterilization of sources and treatment applicators • Loading of the brachytherapy sources into treatment applicators according to treatment plans/protocols • QC of individual source loading • Issue and receipt of brachytherapy sources • Management of radiation sources, including: ° Acquisition ° Custody ° Disposal • Handle records and documentation

	MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT
Objectives	**To provide Residents with:** • **knowledge and competencies relating to the professional aspects of their roles and responsibilities and principles and practice of quality management in a radiotherapy department.**
Competencies Addressed in this Module	• Professional awareness. • High level of oral and written communication, and interpretation skills. • Appropriate level of general management skills. • Knowledge and basic skills in information technology. • Design of the structure of a quality management system • Design and performance of a quality assurance programme required for the clinical implementation of new equipment.
Expected time commitment	7 – 12 % of entire programme (Note: management and communication skills must be developed throughout all years of training and skills are interwoven within all modules)
Pre-Requisite Knowledge	LEER, J.W.H., MCKENZIE, A., SCALLIET, P., THWAITES, D.I., Practical guidelines for the implementation of a quality system in radiotherapy – ESTRO booklet #4.(1998). http://www.estroweb.org/estro/index.cfm. PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing, Madison WI, (1999).
Sub-Modules	7.1 Professional Awareness 7.2 Communication 7.3 General Management 7.4 Information Technology 7.5 Quality Management Systems 7.6 Quality Management for the Implementation of New Equipment
Supplementary Reading List	• ESTRO publications (various). http://www.estroweb.org/estro/index.cfm • http://www.edu.uwo.ca/conted/mentor/index.asp • ISO • QART • Lowe W. Networking for Dummies. Wiley, 2005. • Robbins A. Unix in a Nutshell. 4th Edition. O'Reilly Media. 2005. • Venables J. Communication Skills for Engineers and Scientists. 3rd Edition. Institute of Chemical Engineers. 2202. • National Health and Medical Research Council (Australia). Communicating with patients: advice for medical practitioners 2004. Available at http://www.nhmrc.gov.au/documents/_files/e58.pdf

	Module 7: Professional Studies and Quality Management
	Sub-module 7.1: Professional Awareness
Objective	To demonstrate an understanding of and participate in (if possible) activities related to professional awareness.
Competency Addressed	Professional awareness.
Recommended Items of Training	**Career Planning** • Demonstrate an understanding of the scope of practice and career structure of Radiation Oncology Physicists. • Demonstrate an understanding of the opportunities and restrictions in career progression. • Draw a tree diagram summarising your Medical Physics department's staff structure, including your position. • Define your own career plan. **Professional Organisation Activities** • Demonstrate an awareness of the professional organisation including the structure of your professional organisation including identifying key office bearers and administrative staff. • Attend and actively participate in professional activities. • Review website of medical physics professional organisations • Demonstrate an awareness of topical issues affecting your profession and professional organisation. • Demonstrate an awareness of the organisations representing your professional body and other allied organisations and locate the relevant websites. • Demonstrate of the awareness of international agencies and professional bodies as related to Radiation Oncology Physics. **Professional Issues** **i. Ethics** • Demonstrate an understanding of your professional organisation and hospital's policies and procedures on professional and clinical ethics. • Demonstrate an awareness of the code of conduct and mission statement for your professional organisation and hospital. • Understand the requirements for ethics clearance for clinical research projects. • Understand the requirements of privacy of staff and patient information. **ii. Legal Issues** • Outline the objectives, definition and requirements of/for legal issues at your institution/s (e.g. hospital and university if relevant) and in your state and country as related to Radiation Oncology Medical Physicists. This should include the policies on conflict of interest and legislation and regulatory matters. • Outline the requirements of radiation incident reporting. • Awareness of data protection legislation.

	iii. Intellectual Property • Understand the types of intellectual property. • Outline the objectives, definition and requirements of/for intellectual property at your institution/s (e.g. hospital and university if relevant). • Outline ownership of material produced as a result of your research at your institution. • Demonstrate an awareness of vendor intellectual property requirements in the workplace, including software licensing and warranties. **Continual Professional Development** • Demonstrate an awareness of the objective of CPD. • Demonstrate an awareness of legislation and/or professional organisation requirements for CPD.
	Module 7: Professional Studies and Quality Management
	Sub-module 7.2: Communication
Objective	To be a good communicator within a multi-disciplinary team, with patients and the general public.
Competencies Addressed	Oral and written communication and interpretation skills.

Recommended Items of Training	**Oral Skills**
	
	• Attend a course on
	  ◦ Oral presentation competencies,
	  ◦ Mentoring competencies, and/or
	  ◦ Conducting professional meetings.
	• Actively participate in physics department meetings (chair a meeting if possible).
	• Actively participate in Radiation Oncology Department technical meetings e.g. reviewing patients' set-up and treatment techniques.
	• Scientific presentation at meeting of Medical Physicists, multi-disciplinary professionals or an audience containing members of the general public.
	• Medical Physics tutoring for other Radiation Oncology professionals. Examples include Radiation Safety lectures and tutorials to Radiation Oncology Registrars.
	• Actively participate in project progress meetings during equipment commissioning.
	• Presentation of research results at a national and/or international conference/meeting.
	• Communicate with a patient (in a mock or real scenario), such as the purpose and method of in-vivo dosimetry to a patient you are about to perform a measurement on.
	• Provide accurate, clear, clinical medical physics advice regarding patient set-up, planning or treatment to other Radiation Oncology Professionals (via in-vivo dosimetry, specialised treatment techniques, consultation in the simulator room, etc).

	Written Skills • Demonstrate understanding of professional issues such as legal consequences of information documented and forwarded via email, confidentiality, sensitivity and permission to use data. • Demonstrate understanding of appropriate format and style of professional written communication, including email, memos and letters. • Keep a logbook • Write an example of a professional letter, email and memo that you could send to a key manager in the Radiation Oncology Department addressing a medical physics issue. • Write a brief technical report on a patient case study e.g. *in vivo* dosimetry, specialised treatment technique or patient treated with brachytherapy. • Write a business case to management regarding new or replacement radiotherapy equipment. • Write or review a protocol for a new or revised treatment technique commissioned by Department. • Write a progress and/or final report for commissioning of new radiotherapy equipment to Radiation Oncology Department. **Comprehension Skills** ◦ Participate in department meetings to review journal papers ◦ Present a review of an international technical protocol to Physics Department
	Module 7: Professional Studies and Quality Management
	Sub-module 7.3: General Management
Objective	To develop capability in managing equipment, a project and/or staff, including liaising with other professional groups.
Competency Addressed	Appropriate level of general management skills
Recommended Items of Training	• Participate in project management of the installation and/or commissioning of a therapy unit. • Manage a budget for a small research project • Supervise and mentor technical staff to successfully complete a project on schedule. • Manage a section of the department for a period of time including liaising with other professional groups. • Manage a treatment planning system or linear accelerator (i.e. managing decisions on occasion necessary in short time frames). • Supervise the maintenance of therapy and simulation units, such as: ◦ Participate in trouble-shooting equipment faults for a period of time. ◦ Assume responsibility for each unit for a period of time, including being a contact point for equipment faults and liaising with engineers. ◦ Write a report and/or present to the physics department case studies outlining the equipment fault, its cause and required verification measurements required to ensure accurate dose delivery. ◦ Understand differences between units from different manufacturers.

	• Attend a course on ◦ Time management ◦ Conflict resolution ◦ Performance management
	Module 7: Professional Studies and Quality Management
	Sub-module 7.4: Information Technology
Objective	To be competent with personal computers (PC), interfacing, networking, data storage, and knowledge of Radiation Oncology information technology systems.
Competency Addressed	Knowledge and basic skills in information technology.
Recommended Items of Training	• Demonstrate understanding of electronic communication standards (e.g. Ethernet, FTP, DICOM, DICOM-RT, HL7, etc) • Demonstrate understanding of types and applications of databases in Radiation Oncology • Demonstrate understanding of information technology systems related to Radiation Oncology (e.g. Patient administration systems (PAS), MIMS (database for drugs), pathology, PACS (picture archiving), Incident Management System (IMS)) including various level of user rights. • Demonstrate understanding of professional IT issues such as privacy, confidentiality, sensitivity and permission to use data. • Demonstrate understanding of storage media and how to use them. • Set-up two computers to be able to communicate via DICOM using freeware DICOM tools. • Interface peripheral devices to PCs and treatment planning system (e.g. printers, scanners, fax, USB, serial, parallel, etc). • Perform data reporting, analysis and presentation using Microsoft Office applications (e.g. Work, Excel, PowerPoint) • Demonstrate understanding and ability to use tools for backing up radiotherapy and PC data. • Demonstrate understanding and ability to use Radiation Oncology Information Technology systems such as Record and verify system, data acquisition, linear accelerators, internet, TLD reader software and treatment planning system.
	Module 7: Professional Studies and Quality Management
	Sub-module 7.5: Quality management systems
Objective	To develop an understanding of the principal requirements and elements for a quality management system**.**
Competencies Addressed	Competent in designing the structure of a quality management system.
Recommended Items of Training	• Explain the meaning of relevant terms such as quality, quality process, quality assurance, quality control or quality audit • Demonstrate an understanding of the role of quality management in radiotherapy • Discuss key elements of a quality management system:

	○ documentation of quality policy ○ documentation of quality procedures (quality manual) • Analyze the patient work flow • Design the structure of a quality manual and apply it to a representative selection of items • Participate in a relevant course (either at the management or at the professional level)
	Module 7: Professional Studies and Quality Management
	Sub-module 7.6: Quality management for the implementation of new equipment
Objective	To develop the skill in quality management required for the clinical implementation of new equipment.
Competency Addressed	Competent in designing and performing a quality assurance programme required for the clinical implementation of new equipment.
Recommended Items of Training	• Demonstrate an understanding of generic steps with the clinical implementation such as ○ clinical needs assessment ○ specification, purchase process ○ acceptance tests ○ commissioning ○ periodic tests • Exercise the implementation of at least one radiation facility (external beam therapy facility, afterloading facility) including beam calibration • Exercise the implementation of further items of equipment used in radiotherapy such as ○ equipment for imaging (simulator, CT, etc) ○ dosimetry systems ○ beam modifying and shaping equipment ○ network equipment • Demonstrate an understanding of the key steps of the commissioning of a computerized planning system • Demonstrate an understanding of a representative selection of steps required for the commissioning of a computerized planning system • Perform a patient specific quality assurance check of a computerized planning system

	MODULE 8: RESEARCH, DEVELOPMENT AND TEACHING
Objective	To develop key skills in research, development and teaching in Radiation Oncology Physics as part of a multidisciplinary team.
Core Competencies Addressed in this Module	• Ability to carry out research and development in Radiation Oncology Physics and instrumentation. • Ability to be an effective member of the Radiation Oncology research team. • Ability to teach radiation and general physics.
Expected Time Commitment	10 – 15% of entire programme
Sub-Modules	8.1 Research and Development 8.2 Teaching
Core Reading List	AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, A guide to the teaching of clinical radiological physics to residents in diagnostic and therapeutic radiology, AAPM Rep. 64, New York (1999). http://www.aapm.org/pubs/reports/rpt_64.PDF. AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE, Quality assurance for clinical trials: A primer for Physicists. 2004 AAPM Rep. 86, New York (2004). http://www.aapm.org/pubs/reports/rpt_86.PDF. ICH/CPMP, Good Clinical Practice: Consolidated Guidelines, International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use Rep. E6 (R1) (1996). http://www.ich.org/cache/compo/276-254-1.html.
Supplementary Reading List	ARPANSA, Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes, Radiation Protection Series Rep. 8, ARPANSA. http://www.arpansa.gov.au/rps8.htm. CROWLEY, J., ANKERST, D.P., (Eds), Handbook of Statistics in Clinical Oncology, 2nd edn., Chapman & Hall/CRC, (2006). HALL, E., GIACCIA, A.J., Radiobiology for the Radiologist, 6th edn, Lippincott Wilkins & Williams, Philadelphia, USA (2006). ICH/CPMP, Statistical Principles for Clinical Trials, International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use Rep. E9 (1998). http://www.ich.org/cache/compo/276-254-1.html. STEEL, G., Basic Clinical Radiobiology, 3rd edn, Arnold Press (2002). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists, Medical Physics Publishing,

	Madison WI, (1999). VAN DYK, J., (Ed.) The Modern Technology of Radiation Oncology, Vol. 2, Medical Physics Publishing, Madison, WI, (2005). WIGG, D.R., Applied Radiobiology and Bio effect Planning, Medical Physics Publication (2001). WOODWORD, M., Epidemiology: Study Design and Data Analysis, 2nd edn, Chapman & Hall/CRC (2005). WOOLFE, J., How to write a PhD Thesis, http://www.phys.unsw.edu.au/~jw/thesis.html Internet articles/resources re: clinical trials http://www.nhmrc.gov.au/ethics/human/issues/trials.htm http://www.tga.gov.au/docs/html/ich13595.htm http://www.arpansa.gov.au/rps8.htm http://www.edu.uwo.ca/conted/mentor/index.asp
	Module 8: Research, Development and Teaching
	Sub-module 8.1: Research and Development
Objectives	To develop: • Attributes required to be an effective member of a Radiation Oncology research team, and scientific skills and acumen in research and development by contributing to a scientific project related to Radiation Oncology.
Competency Addressed	Ability to carry out research and development in Radiation Oncology Physics and instrumentation either individually or as a member of a team
Recommended Items of Training	• Participate in a research and/or development project in Radiation Oncology including tasks such as: o Define an area for research, including the specific question which is being asked, in consultation with other physicists in the department. o Formulate hypotheses. o Review the literature in the area effectively and critically and provide this in a written report (including the clinical benefits of the research or development). o Continually monitor current advances in research and development in the chosen area of research. o Determine a project plan for the project including, milestones, necessary experiments and analysis and time frames. o Select and use appropriate equipment and scientific methodology. o Assess and quantify uncertainty in experimental methods. o Publication or presentation of results at a national or international level. o Write a reply to reviewers' comments and make necessary changes. o Liaise with research/technical assistants. o Defend research results to an audience. • Write a small to medium research grant application.

	• Participate in the improvement of the Medical Physics service. • In consultation with other department members, determine a collaborative project within the department that you can be involved with. • Apply relevant medical physics knowledge to assist with clinical trials, statistical methods and mathematical modelling in association with medical staff, data managers and/or statisticians, such as. o Provide dosimetry advice to Radiation Oncologists regarding a clinical trial, as well as: ▪ Demonstrate an understanding of the characteristics of clinical trials, including those currently being conducted locally and ▪ Awareness of the role of multidisciplinary professionals in the execution and evaluation of Clinical Trials. o Collaborate with medical staff, data managers and statisticians by assisting with the use of statistical methods and mathematical modelling in Radiation Oncology.
	Module 8: Research, Development and Teaching
	Sub-module 8.2: Teaching
Objective	To develop the attributes required to be an effective educator and mentor in radiation oncology physics.
Competency Addressed	• Ability to teach radiation and general physics.
Recommended Items of Training	• Attend a general course (if available) on how to teach scientific material. • Develop familiarity with teaching techniques, including understanding the needs of particular audiences. • Teach radiation and general physics (including radiation safety) to different audiences (e.g. radiation therapists, medical staff, students, junior physicists, etc) • Attend a general course (if available) on mentoring or clinical supervision for health professionals. • Understand the differences between individual and group learning. • Understand the requirements of adult education and professional development.

APPENDIX I. COMPETENCY ASSESSMENT

EXPLANATION OF COMPETENCY ASSESSMENT PROCESS

This *Clinical Training Programme Guide* is divided into eight modules. Each module defines a unified portion of clinical knowledge or experience required of a Medical Physicist specialising in Radiation Oncology.

The modules are further divided into sub-modules which address particular competencies. The sub-modules to be undertaken and the level of competency required to be achieved in **each sub-module** have been determined by the Responsible National Authority or its delegate and are indicated in the assessment matrices provided below.

There are generally five levels of competency to consider. Level 5 is a basic level of competency and level one is a high level of competency. The levels have descriptive indicators to assist in maintaining a consistent approach to assessment of competency. The descriptive indicator for a level needs to be considered in relation to the indicator for lower levels of competency. For example, when considering assessment at level 3 also ensure that the Resident has demonstrated the levels of competency indicated by levels 5 and 4.

A Resident may progress more than one level at the time of an assessment. Likewise they might in the first assessment of their competency in a particular sub-module be assessed at any level. It is also possible that they might regress from one assessment to the next. i.e. be assessed at level 3 and then at a later date at level 4. A hypothetical assessment of a sub-module is provided below (page 7).

As demonstrated by the criteria, competency assessment is not just reviewing technical ability but also professional attributes, such as safe practice and communication skills, expected of a qualified medical physicist specialising in radiation oncology.

IMPORTANT NOTES:

- This document should be retained by the Resident for the duration of his/her clinical training programme. It may be reviewed by the National Programme Coordinator or other responsible person at any time. It must also be made available to the National Programme Coordinator just prior to the final oral examination.
- It is recommended that a copy is made of this document at regular intervals and that this copy is retained by the Clinical Supervisor. In the event that the Resident loses their copy then the Clinical Supervisor's copy provides a reasonably up to date record of competency assessment.
- The assessment matrix for each sub-module is provided from page 14 onwards. Pages 8-13 are an "Assessment Summary" which provides a quick reference to progress.

AN EXAMPLE OF THE ASSESSMENT MATRIX OF A SUB-MODULE

Sub-module 6.5: Calibration of Brachytherapy Sources

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Understands the principles and processes in the calibration of brachytherapy sources.	Demonstrates a limited understanding of the principles and processes. Has observed but not performed the calibration of sources.	Demonstrates a good understanding of the principles and processes. Requires close supervision to ensure error free calibration of sources.	Demonstrates a good understanding of the principles and processes. Requires only limited supervision in performing a calibration. Occasionally makes significant errors.	Demonstrates a good understanding of the principles and processes and is able to perform calibration of sources unsupervised. Makes occasional minor errors which do not have clinical impact.	Demonstrates a good understanding of the principles and processes and is able to perform calibration of sources unsupervised and to an acceptable clinical standard.
Date Achieved		24 Jan 2007	2 April 2007	1 May 2007	
Supervisor's Initials		*MeL*	*MeL*	*MeL*	

Date	**Supervisor comments (referring to assessment criteria & recommended items of training).**
24 Jan 2007	Understands the principles of calibration of sources but has not yet developed the necessary skills.
2 April 2007	Has developed the skills required for safe handling of sources and is able to perform the protocol for calibration of brachytherapy sources. Needs some help with understanding the uncertainties.
1 May 2007	Capable of calibrating sources and preparing source data for treatment planning and a calibration report. Understands the full range of activities required for this competency.

ASSESSMENT SUMMARY

Module 1: Clinical Introduction

Sub-module	Level of Competency Achieved		
	3	**2**	**1**
1.1 Clinical Aspects of Radiobiology			
1.2 Introduction to Radiation Oncology			
1.3 Anatomy			

Sub-module	Date when 2 requirements completed	Date when 4 requirements completed	Date when 6 requirements completed	Date when all requirements completed
1.4 Patient Related Clinical Experiences				

Module 2: Radiation Safety and Protection

Sub-module	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
2.1 Principal requirements					
2.2 Local organisation.					
2.3 Procedures.					
2.4 Safety of radiation sources.					
a. Radiation safety and protection procedures for radiation sources.					
b. Duties of a radiation safety officer in Radiation Oncology					
c. Management of disused sources and waste.					
2.5. Radiation protection design of treatment rooms					
2.6. Protection against medical exposure, occupational and public exposure					
2.7. Emergency handling					
2.8 Radiation safety in brachytherapy					
2.9 Radiation protection design of brachytherapy rooms					

ASSESSMENT SUMMARY (cont'd)

Module 3: Radiation Dosimetry for External Beam Therapy

Sub-module	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
3.1 Dosimetry operations using ionisation chambers					
3.2 Dosimetry operations using other methods					
3.3 Absolute absorbed dose measurements					
3.4 Relative dose measurements					
3.5 Patient dose verification					
3.6 In-vivo dosimetry					
3.7 QA in dosimetry					

Module 4: Radiation Therapy – External Beam

Sub-module	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
4.1 Treatment and Imaging Equipment					
4.2 Specifications and acquisition of new equipment					
4.3 Quality Assurance of External Beam Equipment I – Acceptance Testing					
a. for an Orthovoltage Therapy Unit					
b. for a Megavoltage Therapy Unit					
c. for a Simulator/Simulator-CT and/or CT scanner/CT-simulator					
4.4 Quality Assurance of External Beam Equipment II – Commissioning					
a. for an Orthovoltage Therapy Unit					
b. for a Megavoltage Therapy Unit					
c. for a Simulator/Simulator-CT and/or CT scanner/CT-simulator					
4.5 Quality Assurance of External Beam Equipment III – Quality Control					
a. for an Orthovoltage Therapy Unit					
b. for a Megavoltage Therapy Unit					
c. for a Simulator/Simulator-CT and/or CT scanner/CT-simulator					
4.6 Operational Procedures for External Beam Equipment					
4.7 Treatment Techniques					
4.8 Patient Positioning and Treatment Verification					
a. devices and methods of patient and tumour localisation					
b. dose verification					

ASSESSMENT SUMMARY (cont'd)

Sub-module	Level of Competency Achieved				
	5	4	3	2	1
5.1 Procurement of treatment planning computer					
5.2 Quality Assurance in Treatment Planning					
a. Acceptance testing					
b, Commissioning a RTPS					
c. Quality control of a RTPS					
5.3 Planning computer system administration					
5.4 Acquisition of patient data					
a. Acquisition and use of patient image data for treatment planning					
b. Uncertainties involved in the patient data acquired for treatment planning					
5.5 Treatment Planning					
a. Manual treatment planning and dose calculation					
b. Computer assisted treatment planning, dose optimisation and evaluation					
c. Planning of new treatment techniques					
d. QC of individual treatment plans					

Module 5: External Beam Treatment Planning

ASSESSMENT SUMMARY (cont'd)

Module 6: Brachytherapy

Sub-module	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
6.1 Procurement					
6.2 Quality Assurance in Brachytherapy I – Acceptance Testing					
6.3 Quality Assurance in Brachytherapy II – Commissioning					
6.4 Quality Assurance in Brachytherapy III – Quality Control					
6.5 Calibration of Brachytherapy Sources					
6.6 Acquisition of Image and Source Data for Treatment Planning					
a. Obtaining/verifying patient anatomical information and radiation source geometry					
b. Inputting of data to planning system					
6.7 Treatment Planning					
a. Manual planning and dose calculations in brachytherapy					
b. Computer assisted planning					
c. Quality control of treatment plans					
6.8 Source Preparation					

ASSESSMENT SUMMARY (cont'd)

Module 7: Professional Studies and Quality Management

Sub-module	Level of Competency Achieved				
	5	4	3	2	1
7.1 Professional Awareness					
7.2 Communication					
7.3 General Management					
7.4 Information Technology					
7.5 Quality Management Systems					
7.6 Quality Management for the Implementation of New Equipment					

Module 8: Research, development and teaching

Sub-module	Level of Competency Achieved				
	5	4	3	2	1
8.1 Research and Development					
8.2 Teaching					

MODULE 1: CLINICAL INTRODUCTION

Sub-modules

1.1: Clinical Aspects of Radiobiology
1.2: Introduction to Radiation Oncology
1.3: Anatomy
1.4 Patient Related Clinical Experiences

Sub-module 1.1: Clinical Aspects of Radiobiology

Knowledge	**Level of Competency Achieved**		
	3	**2**	**1**
A basic understanding of the clinical aspects of Radiobiology.	Demonstrates a limited understanding of relevant clinical aspects of radiobiology.	Demonstrates a good understanding of relevant clinical aspects of radiobiology.	Demonstrates an excellent understanding of relevant clinical aspects of radiobiology.
Date Achieved			
Supervisor Initials			

Date	**Supervisor comments (referring to assessment criteria & recommended items of training).**

MODULE 1: CLINICAL INTRODUCTION (cont'd)

Sub-module 1.2: Introduction to Radiation Oncology

Knowledge	Level of Competency Achieved		
	3	2	1
A basic understanding of cancer and radiation oncology suitable for medical physicists.	Demonstrates a limited understanding of the disease process in cancer and the role of radiation therapy in its treatment.	Demonstrates a good understanding of the disease process in cancer and the role of radiation therapy in its treatment.	Demonstrates an excellent understanding of the disease process in cancer and the role of radiation therapy in its treatment.
Date Achieved			
Supervisor Initials			

Date	Supervisor comments (referring to assessment criteria & recommended items of training).

Sub-module 1.3: Anatomy

Knowledge	Level of Competency Achieved		
	3	2	1
A basic knowledge of anatomy appropriate for medical physicists.	Demonstrates a limited understanding of relevant anatomy	Demonstrates a good understanding of relevant anatomy	Demonstrates an excellent understanding of relevant anatomy
Date Achieved			
Supervisor Initials			

Date	Supervisor comments (referring to assessment criteria & recommended items of training).

MODULE 1: CLINICAL INTRODUCTION (cont'd)

Sub-module 1.4: Patient Related Clinical Experiences

	Experience		Report	
Experience	**Y/N**	**Date(s)**	**Received Y/N**	**Satisfactory/ Unsatisfactory**
Attend at least two ward rounds				
Attend the new patient clinics				
Attend and observe the manufacture of treatment aids.				
Attend and observe the operation of a simulator or CT unit.				
Attend and observe the operation of a radiation treatment unit.				
Case Studies				
Operating room				
Attend the imaging department				

MODULE 2: RADIATION SAFETY AND PROTECTION

Sub-modules

2.1: .Principal requirements..
2.2: Local organisation.
2.3: Procedures
2.4: Safety of radiation sources.
  a. Radiation safety and protection procedures for radiation sources.
  b. Duties of a radiation safety officer in Radiation Oncology
  c. Management of disused sources and waste.
2.5: Radiation protection design of treatment rooms
2.6: Protection against medical exposure, occupational and public exposure
2.7: Emergency situations
2.8 Radiation Safety in Brachytherapy
2.9 Radiation Protection Design of Brachytherapy Treatment Rooms

Sub-module 2.1: Principal Requirements.

Criterion/ Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Understanding of and the ability to apply the principal requirements of radiation protection management.	Demonstrates a basic understanding of the local QA programme for radiation protection and is able to compare this with international standards.	Demonstrates a good understanding of the local QA programme for radiation protection. Has limited ability to interpret the relevant legislative requirements.	Demonstrates a good understanding of the local QA programme for radiation protection. Has the ability to interpret the relevant legislative requirements. Requires guidance with more difficult concepts.	Demonstrates an excellent understanding of the local QA programme for radiation protection. Has the ability to interpret the relevant legislative requirements including the more difficult concepts.	Is capable of independent assessment of the requirements of a radiation protection management plan.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.2: Local Organisation.

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to assess local radiation protection guidelines and to interpret new guidelines.	Demonstrates a limited understanding of local radiation protection regulations.	Demonstrates a good understanding of and is capable of evaluating the local radiation protection laws and regulations. Requires guidance with interpretation of more difficult concepts.	Demonstrates a good ability to interpret local radiation protection guidelines. Appreciates the responsibilities of personnel with respect to radiation protection.	Demonstrates a high level of understanding of local radiation protection guidelines and is able to instruct others in their interpretation.	Is capable of independent assessment of local radiation protection guidelines and is able to interpret new guidelines.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.3: Procedures

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Possesses necessary knowledge and skills to perform radiation safety and protection procedures according to local requirements.	Demonstrate a basic understanding of selection, calibration and principles of survey meters and radiation monitors.	Demonstrates a good understanding of selection, calibration and principles of survey meters and radiation monitors and is capable of performing a radiation survey of an area. Requires guidance with the interpretation of results.	Demonstrates the ability to perform a radiation survey of an area and to independently interpret the results. Limited ability to develop operating instructions for equipment.	Demonstrates a high level of ability to perform a radiation survey of an area and to independently interpret the results. Able to independently develop operating instructions for equipment.	Demonstrates the ability to independently perform all duties associated with radiation safety and protection in the department at a satisfactory level.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.4a: Safety of Radiation Sources (Radiation Safety and Protection Procedures)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Possesses necessary knowledge and skills to perform radiation safety and protection procedures for radiation sources according to local requirements.	Demonstrates a basic knowledge of the principles involved in the safe handling of radiation sources.	Demonstrates a good knowledge of the principles involved in the safe handling of radiation sources.	Demonstrates an ability to perform shielding design calculations for LINACS, simulators etc. Needs some assistance with the designs and makes occasional significant errors.	Demonstrates an ability to independently perform shielding design calculations for LINACS, simulators etc. Makes only minor errors.	Demonstrates an ability to independently perform shielding design calculations for LINACS, simulators etc. to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.4b: Safety of Radiation Sources (Duties of a Radiation Safety Officer in Radiation Oncology)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Is able to perform the duties of a radiation safety officer in Radiation Oncology	Demonstrates a limited knowledge of the duties of a Radiation Safety Officer (RSO).	Demonstrates a good knowledge of the duties of a RSO. Not sufficiently competent to perform the duties of an RSO or source custodian.	Demonstrates a good knowledge of the safety and quality control procedures. Able to perform the duties of an RSO or source custodian at a basic level. However requires considerable supervision.	Demonstrates a good knowledge and is able to perform the duties of an RSO or source custodian with only limited supervision.	Demonstrates a very good ability to perform the duties of an RSO or source custodian at a satisfactory level without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.4c: Safety of Radiation Sources (Management of Disused Sources and Waste)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to manage disused sources and waste.	Demonstrates a basic knowledge of the principles of management of disused sources and waste.	Demonstrates a good knowledge of the principles of management of disused sources and waste. Has participated, in the return of a disused source.	Capable of managing radioactive waste or the return of a disused source. Requires significant supervision.	Capable of managing radioactive waste or the return of a disused source. Requires only limited supervision.	Has the ability to take responsibility for all aspects of the return of a disused source or to manage radioactive waste safely.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.5: Radiation Protection Design of Treatment Rooms

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Design of room shielding in treatment facilities.	Demonstrates a limited knowledge of relevant local and international standards.	Demonstrates a good knowledge of relevant local and international standards. Able to perform a risk assessment and to design room shielding. Requires close supervision.	Demonstrates a good ability to perform a risk assessment and to design room shielding. Capable of performing radiation surveys and monitoring. Requires only limited supervision. Occasionally makes significant errors.	Demonstrates a good ability to perform a risk assessment and to design room shielding. Capable of performing radiation surveys and monitoring. Requires only limited supervision. Makes occasional minor errors which do not have significant clinical impact.	Demonstrates a good ability to perform a risk assessment and to design room shielding. Capable of performing radiation surveys and monitoring. Capable of performing these duties to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.6: Protection Against Medical, Occupational and Public Exposure

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Knowledge and skills required to provide protection in relation to medical, occupational and public exposure.	Demonstrates a basic knowledge of the principles appropriate to radiation protection with respect to medical, occupational and public exposure.	Demonstrates a good knowledge of the principles appropriate to radiation protection with respect to medical, occupational and public exposure.	Demonstrates an ability to perform calibration checks of external beam radiotherapy equipment and source strength. Makes occasional significant errors.	Demonstrates an ability to independently perform calibration checks of external beam radiotherapy equipment and source strength. Makes only minor errors.	Demonstrates an ability to independently perform calibration checks of external beam radiotherapy equipment and source strength to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.7: Emergency Situations

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to reach correct decisions in emergency situations.	Demonstrates a basic knowledge of the principles appropriate to radiation protection in emergency situations.	Demonstrates a good knowledge of the principles appropriate to radiation protection in emergency situations and is capable of performing a risk assessment of a procedure under supervision.	Demonstrates an ability to perform a risk assessment of a procedure without supervision. Makes only minor errors.	Demonstrates, through practice of contingency measures or otherwise, the capability to make correct decisions in emergency situations with only minor errors.	Demonstrates, through practice of contingency measures or otherwise, the capability to always make correct decisions in emergency situations.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.8: Radiation Safety in Brachytherapy

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to perform the role of a radiation safety officer or source custodian in brachytherapy and to take appropriate safety and quality control procedures in brachytherapy treatment	Demonstrates a limited knowledge of the safety and quality control procedures of brachytherapy.	Demonstrates a good knowledge of the safety and quality control procedures. Not sufficiently competent to perform the duties of an RSO or source custodian.	Demonstrates a good knowledge of the safety and quality control procedures. Able to perform the duties of an RSO or source custodian at a basic level and to take appropriate safety and quality control procedures in brachytherapy treatment. Requires considerable supervision.	Demonstrates a good knowledge and is able to perform the duties of an RSO or source custodian and to take appropriate safety and quality control procedures in brachytherapy with only limited supervision.	Is capable to independently perform the duties of an RSO or source custodian and to take appropriate safety and quality control procedures in brachytherapy.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 2: RADIATION SAFETY AND PROTECTION (cont'd)

Sub-module 2.9: Radiation Protection Design of Brachytherapy Treatment Rooms

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Conduct of radiation risk assessment, design of room and source shielding in brachytherapy treatment facilities. Radiation survey and monitoring	Demonstrates a limited knowledge of relevant local and international standards and recommendations on radiation safety and protection.	Demonstrates a good knowledge of relevant local and international standards. Able to perform a risk assessment and to design room and source shielding requirements. Requires close supervision.	Demonstrates a good ability to perform a risk assessment and to design room and source shielding requirements. Capable of performing radiation surveys and monitoring. Requires only limited supervision. Occasionally makes significant errors when unsupervised.	Demonstrates a good ability to perform a risk assessment and to design room and source shielding. Capable of performing radiation surveys and monitoring. Requires only limited supervision. Makes occasional minor errors which do not have significant clinical impact.	Demonstrates a good ability to perform a risk assessment and to design room and source shielding. Capable of performing radiation surveys and monitoring. Capable of performing these duties to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY

Sub-modules

3.1 Dosimetry operations using ionisation chambers
3.2 Dosimetry operations using other methods
3.3 Absolute absorbed dose measurements
3.4 Relative dose measurements
3.5 Patient dose verification
3.6 In-vivo dosimetry
3.7 QA in dosimetry

Sub-module 3.1: Dosimetry Operations Using Ionisation Chambers

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Capability in the use and understanding of ionisation chambers for relative and absolute determination of absorbed dose to water in radiotherapy beams.	Demonstrates a limited understanding of the physical principles of ionisation chambers for relative and absolute determination of absorbed dose.	Demonstrates a good understanding of the physical principles of ionisation chambers for relative and absolute determination of absorbed dose. Able to perform such measures with supervision.	Demonstrates a good understanding of the physical principles of ionisation chambers for relative and absolute determination of absorbed dose. Able to perform such measures without supervision but results require checking.	Demonstrates a good understanding of the physical principles of ionisation chambers for relative and absolute determination of absorbed dose. Able to perform such measures without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of the physical principles of ionisation chambers for relative and absolute determination of absorbed dose. Able to perform such measures to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.2: Dosimetry Operations Using Other Methods

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capable of performing dose measurements in radiotherapy beams using a range of dosimeters.	Demonstrates a limited understanding of the physical principles of appropriate dosimeters (e.g. TLDs, film or solid state dosimeters)	Demonstrates a good understanding of the physical principles of appropriate dosimeters. Able to use available dosimeters to perform dose measurements with supervision.	Demonstrates a good understanding of the physical principles of appropriate dosimeters. Able to perform dose measurements without supervision but results require checking.	Demonstrates a good understanding of the physical principles of appropriate dosimeters. Able to perform dose measurements without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of the physical principles of appropriate dosimeters. Able to perform dose measurements to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.3: Absolute absorbed dose measurements

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capable to perform absorbed dose determination in external beam radiotherapy	Demonstrates a limited understanding of the calibration of ionisation chambers.	Demonstrates a good understanding of the calibration of ionisation chambers. Able to calibrate ionisation chambers with supervision.	Demonstrates a good understanding of the calibration of ionisation chambers. Able to calibrate ionisation chambers without supervision. Results require checking.	Demonstrates a good understanding of the calibration of ionisation chambers. Able to calibrate ionisation chambers without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of the calibration of ionisation chambers. Able to calibrate ionisation chambers to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.4: Relative dose measurements

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capable of performing relative dose measurements in external beam radiotherapy.	Demonstrates a limited understanding of dosimetric requirements for phantoms used in radiotherapy.	Demonstrates a good understanding of dosimetric requirements for phantoms used in radiotherapy. Able to use appropriate equipment for measurement of dose parameters and dose distribution in radiotherapy beams. Requires close supervision.	Demonstrates a good understanding of dosimetric requirements for phantoms used in radiotherapy. Able to use appropriate equipment for measurement of dose parameters and dose distribution in radiotherapy beams. Requires only limited supervision. Results require checking.	Demonstrates a good understanding of dosimetric requirements for phantoms used in radiotherapy. Able to use appropriate equipment for measurement of dose parameters and dose distribution in radiotherapy beams. without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of dosimetric requirements for phantoms used in radiotherapy. Able to use appropriate equipment for measurement of dose parameters and dose distribution in radiotherapy beams to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.5: Patient dose verification

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
To be able to perform and analyse dose verification measurements in a phantom in order to decide on acceptance of a treatment plan.	Demonstrates a limited understanding of the procedures of dose verification.	Demonstrates a good understanding of the procedures of dose verification. Able to apply these procedures with supervision.	Demonstrates a good understanding of the procedures of dose verification. Able to apply these procedures without supervision. Results require checking.	Demonstrates a good understanding of the procedures of dose verification. Able to apply these procedures without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of the procedures of dose verification. Able to apply these procedures to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.6: In-vivo dosimetry

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Able to monitor the accuracy of dose planned and delivered to Individual patients, patient groups, in standard treatment techniques and in special or new treatment techniques.	Demonstrates a limited understanding of the requirements to monitor the accuracy of dose delivery.	Demonstrates a good understanding of the requirements to monitor the accuracy of dose delivery. Able to perform in-vivo dosimetry measurements for individual patients, patient groups and standard treatment techniques with supervision.	Demonstrates a good understanding of the requirements to monitor the accuracy of dose delivery. Able to perform in-vivo dosimetry measurements for individual patients, patient groups and standard treatment techniques without supervision. Results require checking.	Demonstrates a good understanding of the requirements to monitor the accuracy of dose delivery. Able to perform in-vivo dosimetry measurements for individual patients, patient groups, standard treatment techniques and in special or new treatment techniques without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good understanding of the requirements to monitor the accuracy of dose delivery. Able to perform in-vivo dosimetry measurements for individual patients, patient groups, standard treatment techniques and in special or new treatment techniques to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 3: RADIATION DOSIMETRY FOR EXTERNAL BEAM THERAPY (cont'd)

Sub-module 3.7: QA in dosimetry

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to manage a QA programme for all dosimetry equipment	Demonstrates a limited understanding of QA recommendations for radiation dosimetry equipment and is able to review these recommendations against the department's QA protocol.	Demonstrates a good understanding of QA recommendations for radiation dosimetry equipment and is able to perform the commissioning and QC checks for dosimetry equipment with supervision.	Demonstrates a good familiarity with QA recommendations for radiation dosimetry equipment and is able to perform the commissioning and QC checks for dosimetry equipment with supervision. Results require checking.	Demonstrates a good familiarity with QA recommendations for radiation dosimetry equipment and is able to perform the commissioning and QC checks for dosimetry equipment without supervision. Makes only minor errors which have no clinical significance.	Demonstrates a good familiarity with QA recommendations for radiation dosimetry equipment and is able to perform the commissioning and QC checks for dosimetry equipment to an acceptable clinical standard without supervision.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM

Sub-modules

4.1 Treatment and Imaging Equipment
4.2 Specifications and acquisition of new equipment
4.3 Quality Assurance of External Beam Equipment I – Acceptance Testing of:
- a. an Orthovoltage Therapy Unit
- b. a Megavoltage Therapy Unit
- c. a Simulator/Simulator-CT and/or CT scanner/CT-simulator

4.4 Quality Assurance of External Beam Equipment II – Commissioning
- a. an Orthovoltage Therapy Unit
- b. a Megavoltage Therapy Unit
- c. a Simulator/Simulator-CT and/or CT scanner/CT-simulator

4.5 Quality Assurance of External Beam Equipment III – QC for
- a. an Orthovoltage Therapy Unit
- b. a Megavoltage Therapy Unit
- c. a Simulator/Simulator-CT and/or CT scanner/CT-simulator

4.6 Operational Procedures for External Beam Equipment
4.7 Treatment Techniques
4.8 Patient Positioning and Treatment Verification.
- a. devices and methods of patient and tumour localisation
- b. dose verification.

Sub-module 4.1: Treatment and Imaging Equipment

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Demonstrate an understanding of the physical principles and range of equipment used in Radiation Oncology for treatment and imaging.	Demonstrates a limited understanding of the physical principles of some of the treatment and imaging equipment used in Radiation Oncology.	Demonstrates a limited understanding of the physical principles of the full range of treatment and imaging equipment used in Radiation Oncology.	Demonstrates a good understanding of the physical principles of some of the treatment and imaging equipment used in Radiation Oncology.	Demonstrates a good understanding of the physical principles of the full range of treatment and imaging equipment used in Radiation Oncology.	Demonstrates an excellent understanding of the physical principles of the full range of treatment and imaging equipment used in Radiation Oncology. Is capable of explaining to others these physical principles.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.2: Specifications and acquisition of new equipment

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
To be able to prepare specifications and advice for new equipment in association with other professional and technical staff.	Demonstrates a limited understanding of the procedures for preparation of specifications for new equipment.	Demonstrates a good understanding of the procedures for preparation of specifications for new equipment.	Demonstrates a good understanding of the procedures for preparation of specifications for new equipment and is capable of preparing necessary documentation for a limited range of equipment. Requires close supervision.	Demonstrates a good understanding of the procedures for preparation of specifications for new equipment and is capable of preparing necessary documentation for the full range of equipment with some supervision.	Demonstrates a good understanding of the procedures for preparation of specifications for new equipment and is capable of preparing necessary documentation for the full range of equipment without supervision.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.3a: QA of External Beam Equipment I – Acceptance Testing (Orthovoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform acceptance testing procedures for an orthovoltage therapy unit.	Demonstrates a limited understanding of the concepts and principles of an acceptance testing programme for an orthovoltage therapy unit:	Demonstrates a good understanding of the concepts and principles of an acceptance testing programme for an orthovoltage therapy unit. Is capable of assessing the properties and characteristics of the equipment, including specification and functionality.	Demonstrates a good understanding of the acceptance testing programme for an orthovoltage therapy unit. Able to design appropriate methods and test procedures and to perform the acceptance testing programme with supervision. Makes minor errors.	Able to perform the acceptance testing programme without supervision. Makes minor errors.	Able to independently perform the acceptance testing programme without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.3b: QA of External Beam Equipment I – Acceptance Testing (Megavoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform acceptance testing procedures for a megavoltage therapy unit.	Demonstrates a limited understanding of the concepts and principles of an acceptance testing programme for a megavoltage therapy unit:	Demonstrates a good understanding of the concepts and principles of an acceptance testing programme for a megavoltage therapy unit. Is capable of assessing the properties and characteristics of the equipment, including specification and functionality.	Demonstrates a good understanding of the acceptance testing programme for a megavoltage therapy unit. Able to design appropriate methods and test procedures and to perform the acceptance testing programme with supervision. Makes minor errors.	Able to perform the acceptance testing programme without supervision. Makes minor errors.	Able to independently perform the acceptance testing programme without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.3c: QA of External Beam Equipment I – Acceptance Testing (Simulator/Simulator-CT and/or CT scanner/CT-simulator)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to design and perform acceptance testing procedures for a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a limited understanding of the concepts and principles of an acceptance testing programme for a simulator/simulator-CT and/or CT scanner/CT-simulator.:	Demonstrates a good understanding of the concepts and principles of an acceptance testing programme for a simulator/simulator-CT and/or CT scanner/CT-simulator. Is capable of assessing the properties and characteristics of the equipment, including specification and functionality.	Demonstrates a good understanding of the acceptance testing programme for a simulator/simulator-CT and/or CT scanner/CT-simulator. Able to design appropriate methods and test procedures and to perform the acceptance testing programme with supervision. Makes minor errors.	Able to perform the acceptance testing programme without supervision. Makes minor errors.	Able to independently perform the acceptance testing programme without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.4a: QA of External Beam Equipment II – Commissioning (Orthovoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform acceptance testing procedures for an orthovoltage therapy unit.	Demonstrates a limited understanding of the methods, procedures and tools for commissioning an orthovoltage therapy unit:	Demonstrates a good understanding of the methods, procedures and tools for commissioning an orthovoltage therapy unit.	Demonstrates a good understanding of the methods, procedures and tools for commissioning an orthovoltage therapy unit. Able to design appropriate methods and test procedures and to perform the necessary tests with supervision. Makes significant errors.	Able to perform the commissioning with supervision. Makes only minor errors.	Able to independently perform the commissioning without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.4b: QA of External Beam Equipment II – Commissioning (Megavoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform acceptance testing procedures for a megavoltage therapy unit.	Demonstrates a limited understanding of the methods, procedures and tools for commissioning a megavoltage therapy unit.	Demonstrates a good understanding of the methods, procedures and tools for commissioning a megavoltage therapy unit.	Demonstrates a good understanding of the methods, procedures and tools for commissioning a megavoltage therapy unit. Able to design appropriate methods and test procedures and to perform the necessary tests with supervision. Makes significant errors.	Able to perform the commissioning with supervision. Makes only minor errors.	Able to independently perform the commissioning without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.4c: QA of External Beam Equipment II – Commissioning (Simulator/Simulator-CT and/or CT scanner/CT-simulator)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to design and perform acceptance testing procedures for a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a limited understanding of the methods, procedures and tools for commissioning a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a good understanding of the methods, procedures and tools for commissioning a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a good understanding of the methods, procedures and tools for commissioning a simulator/simulator-CT and/or CT scanner/CT-simulator. Able to design appropriate methods and test procedures and to perform the necessary tests with supervision. Makes significant errors.	Able to perform the commissioning with supervision. Makes only minor errors.	Able to independently perform the commissioning without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.5a: QA of External Beam Equipment III – Quality Control (Orthovoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform quality control of an orthovoltage therapy unit.	Demonstrates a limited understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of an orthovoltage unit:	Demonstrates a good understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of an orthovoltage unit:	Demonstrates a good understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of an orthovoltage unit. Able to design and perform quality control tests with supervision. Makes significant errors.	Able to perform the quality control tests with supervision. Makes only minor errors.	Able to independently perform the quality control tests without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.5b: QA of External Beam Equipment III – Quality Control (Megavoltage therapy unit)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to design and perform quality control of a megavoltage therapy unit.	Demonstrates a limited understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of a megavoltage unit:	Demonstrates a good understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of a megavoltage unit:	Demonstrates a good understanding of the variety of tests, equipment, tolerance and action levels used in the quality control of a megavoltage unit. Able to design and perform quality control tests with supervision. Makes significant errors.	Able to perform the quality control tests with supervision. Makes only minor errors.	Able to independently perform the quality control tests without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.5c: QA of External Beam Equipment III – Quality Control (simulator/simulator-CT and/or CT scanner/CT-simulator)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to design and perform quality control of a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a limited understanding of the variety of tests, equipment, and tolerance and action levels used in the quality control of a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a good understanding of the variety of tests, equipment, and tolerance and action levels used in the quality control of a simulator/simulator-CT and/or CT scanner/CT-simulator.	Demonstrates a good understanding of the variety of tests, equipment, and tolerance and action levels used in the quality control a simulator/simulator-CT and/or CT scanner/CT-simulator. Able to design and perform quality control tests with supervision. Makes significant errors.	Able to perform the quality control tests with supervision. Makes only minor errors.	Able to independently perform the quality control tests without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.6: Operational Procedures for External Beam Equipment

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
To be able to prepare operational procedures for the use of external beam equipment.	Demonstrates a limited capability for the preparation of operational procedures for the use of basic external beam equipment.	Demonstrates a limited capability for the preparation of operational procedures for the use of the full range of external beam equipment.	Demonstrates a good capability for the preparation of operational procedures for the use of the full range of external beam equipment. Work requires checking.	Demonstrates a good capability for the preparation of operational procedures for the use of external beam equipment without significant errors.	Capable of instructing others in the correct operation of external beam equipment.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.7: Treatment Techniques

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Demonstrate an understanding of the purpose, advantages and challenges of a range of beam modifiers and external beam treatment techniques in modern radiotherapy.	Demonstrates a limited understanding of the purposes of most beam modifiers and basic treatment techniques.	Demonstrates a good understanding of the purposes of the full range of beam modifiers and basic treatment techniques.	Demonstrates a good understanding of the purposes of the full range of beam modifiers and basic treatment techniques. Has a limited understanding of more advanced treatment techniques	. Demonstrates a good understanding of the purposes of the full range of beam modifiers and basic treatment techniques. Has a good understanding of more advanced treatment techniques	Demonstrates an excellent understanding of the purposes of the full range of beam modifiers and basic treatment techniques as well as more advanced treatment techniques.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.8a: Patient Positioning and Treatment Verification (Devices and methods of patient and tumour localisation)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Demonstrate an understanding of the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localisation.	Demonstrates a limited understanding of the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localisation.	Demonstrates a good understanding of the purpose, advantages and challenges of a range of devices and methods used for patient and tumour localisation.	Demonstrates an understanding of uncertainties and tolerance levels of devices and methods used for patient and tumour localisation.	Demonstrates an understanding of uncertainties and tolerance levels of devices and methods used for patient and tumour localisation. Has observed their use and manufactured at least one device.	Demonstrates an excellent understanding of uncertainties and tolerance levels of devices and methods used for patient and tumour localisation. Has observed the use of many devices.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 4: RADIATION THERAPY – EXTERNAL BEAM (cont'd)

Sub-module 4.8b: Patient Positioning and Treatment Verification (Dose Verification)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to perform measurements to verify dose delivery accuracy for external beam treatment techniques.	Has a limited understanding of the techniques of dose verification.	Has a good understanding of the techniques of dose verification	Has a good understanding of the techniques of dose verification and is capable of performing treatment verification with supervision. Makes significant errors if unsupervised..	Capable of performing treatment verification without supervision. Makes only minor errors.	Capable of independently performing treatment verification to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING

Sub-modules

5.1 Procurement of a treatment planning computer
5.2 Quality Assurance in treatment planning
  a. Acceptance testing
  b. Commissioning a RTPS
  c. Quality control of a RTPS
5.3 Planning computer system administration
5.4 Acquisition of patient anatomical information.
  a. Acquisition and use of patient image data for treatment planning
  b. Uncertainties involved in the patient data acquired for treatment planning
5.5 Treatment planning
  a. Manual treatment planning and dose calculation
  b Computer assisted treatment planning, dose optimisation and evaluation
  c. Planning of new treatment techniques
  d. QC of individual treatment plans

Sub-module 5.1: Procurement of a treatment planning computer

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Capability to make budgetary requests and acquire, through a tendering process, a suitable treatment planning computer for external beam planning	Demonstrates a limited understanding of the processes involved in equipment requisition and acquisition	Demonstrates a good understanding of the processes involved in equipment requisition and acquisition. Is able to review and report department needs of a TPC but makes significant errors or omissions.	Is able to accurately review and report department needs of a TPC with only a few errors or omissions. Is capable of preparing necessary documents under supervision.	Contributes to the preparation of specifications, evaluation of tenders and recommendation for acquisition of a TPC. Requires guidance with these duties.	Is capable of an independent and error free contribution to the preparation of specifications, evaluation of tenders and recommendation for acquisition of a TPC.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.2a: Quality Assurance in Treatment Planning (Acceptance testing)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capability to perform acceptance testing of a radiotherapy treatment planning system (RTPS)	Demonstrates a limited understanding of the treatment planning process and the potential sources and magnitude of errors	Demonstrates a good understanding of the. treatment planning process and the potential sources and magnitude of errors. Has a limited understanding of the operation, functionality, performance specification and inventory items of an RTPS	Demonstrates a good understanding of the operation, functionality, performance specification and inventory items of an RTPS Able to perform acceptance testing of the RTPS against equipment specification under supervision	Able to perform acceptance testing of the RTPS against equipment specification without supervision. Makes minor errors.	Able to independently perform acceptance testing of the RTPS against equipment specification without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.2b: Quality Assurance in Treatment Planning (Commissioning a RTPS)

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Capability to commission an RTPS	Demonstrates a limited understanding of the processes involved in commissioning a RTPS	Demonstrates a good understanding of the processes involved in commissioning a RTPS. Able to make a limited contribution to the commissioning of a RTPS.	Able to perform the commissioning of a RTPS using an established protocol. Requires close supervision	Able to perform the commissioning of a RTPS and to report any deviations or functional abnormalities and propose corrective actions. Does not require supervision. Makes minor errors.	Able to independently perform the commissioning of a RTPS without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.2c: Quality Assurance in Treatment Planning (QC of a RTPS)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capability to conduct quality control (QC) of a RTPS	Demonstrates a limited understanding of the QC process of a RTPS .	Demonstrates a good understanding of the QC process of a RTPS. Is capable of making a limited contribution to the QC of a RTPS	Able to perform the QC of a RTPS. Requires close supervision	Able to perform the QC of a RTPS. Requires only limited supervision. Capable of identifying and recommending QC test and measurement equipment required as well as tolerance limits and action levels for each QC test Does not require supervision. Makes only minor errors.	Able to independently perform the QC procedures of a RTPS without supervision and to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.3: Planning computer system administration

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to perform the duties of a treatment planning computer system administrator	Demonstrates a limited understanding of the guidelines, policies and administrative measures for a treatment planning computer system	Demonstrates a good understanding of the guidelines, policies and administrative measures for a treatment planning computer system. Capable of performing some of the duties of a PCS administrator.	Able to develop and implement guidelines, policies and administrative measures for a treatment planning computer system. Requires some guidance.	Able to develop and implement guidelines, policies and administrative measures without supervision and to identify and report any deviations or functional abnormalities. Makes only minor errors.	Able to independently perform the duties of a PCS administrator at an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.4a: Acquisition of patient data (Acquisition and use of patient image data for treatment planning).

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to acquire and use patient image data for treatment planning	Demonstrates a limited understanding of patient data required for treatment planning and methods for acquisition of patient data	Demonstrates a good understanding patient data required for treatment planning and methods for acquisition of patient data. Able to perform image registration and contouring under close supervision.	Able to perform image registration and contouring. Requires only limited supervision.	Able to perform image registration and contouring without supervision. Makes only minor errors which have no clinical significance.	Able to perform image registration and contouring without supervision to an acceptable clinical standard and to provide supervision/support and correct advice on acquisition and use of patient data.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.4b: Acquisition of patient data (Uncertainties involved in the patient data acquired for treatment planning).

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to estimate the uncertainties involved in the patient data acquired and to correct/accommodate such errors in treatment planning	Demonstrates a limited understanding of the magnitude and sources of uncertainties involved in image data, contouring of target volumes and critical structures and treatment margins needed for a variety of treatment sites	Demonstrates a good understanding of the magnitude and sources of uncertainties involved in image data, contouring of target volumes and critical structures and treatment margins needed for a variety of treatment sites. Has a limited understanding of the application of ICRU concepts in contouring	Able to apply the ICRU concepts in contouring under supervision. Makes significant errors if unsupervised	Able to apply the ICRU concepts in contouring without close supervision. Makes only minor errors.	Able to independently apply the ICRU concepts in contouring at an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.5a: Treatment Planning (manual treatment planning and dose calculation).

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Perform manual treatment planning and dose calculation	Demonstrates a limited understanding of the principles, methods and procedures of manual treatment planning and treatment simulation	Demonstrates a good understanding of the principles, methods and procedures of manual treatment planning and treatment simulation	Able to perform (by manual methods) planning for a variety of treatments and patient set up conditions under supervision. Makes significant errors if unsupervised	Able to perform (by manual methods) planning for a variety of treatments and patient set up conditions without close supervision. Makes only minor errors.	Able to independently perform (by manual methods) planning for a variety of treatments and patient set up conditions to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.5b: Treatment Planning (Computer assisted treatment planning, dose optimisation and evaluation).

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Use of a treatment planning computers for treatment planning, dose optimisation and evaluation	Demonstrates a limited understanding of the principles, methods and procedures of computer assisted treatment planning, dose optimisation and evaluation.	Demonstrates a good understanding of the principles, methods and procedures of computer assisted treatment planning, dose optimisation and evaluation.	Able to perform (using a planning computer) plans for a variety of treatments and patient set up conditions under supervision. Makes significant errors if unsupervised	Able to perform (using a planning computer) plans for a variety of treatments and patient set up conditions without close supervision. Makes only minor errors.	Able to independently perform (using a planning computer) plans for a variety of treatments and patient set up conditions to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.5c: Treatment Planning (Planning of new treatment techniques).

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Planning of new treatment techniques	Demonstrates a limited understanding of the procedures for development and commissioning of new planning techniques.	Demonstrates a good understanding of the procedures for development and commissioning of new planning techniques. Able to assist with the implementation of new technology in treatment planning	Able to implement new technology in treatment planning. Requires close supervision. Makes significant errors if unsupervised	Able to implement new technology in treatment planning without close supervision. Makes only minor errors.	Able to independently implement new technology in treatment planning to an acceptable clinical standard and to provide training and demonstration to staff on new techniques and procedures
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 5: EXTERNAL BEAM TREATMENT PLANNING (cont'd)

Sub-module 5.5d: Treatment Planning (QC of individual treatment plans).

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Quality control (QC) of individual treatment plans	Demonstrates a limited understanding of the requirements for QC of individual treatment plans.	Demonstrates a good understanding of the requirements for QC of individual treatment plans. Able to check treatment plans with supervision.	Able to check treatment plans without close supervision but makes occasional significant errors. Able to prepare appropriate QC or phantom plans for dosimetry verification with supervision.	Able to check treatment plans and to prepare appropriate QC or phantom plans for dosimetry verification without close supervision. Makes only minor errors.	Able to independently perform all aspects of the QC of individual treatment plans to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY

Sub-modules

6.1 Procurement
6.2 Quality Assurance in Brachytherapy I – Acceptance Testing
6.3 Quality Assurance in Brachytherapy II – Commissioning
6.4 Quality Assurance in Brachytherapy III – Quality Control
6.5 Calibration of Brachytherapy Sources
6.6 Acquisition of Image and Source Data for Treatment Planning
    a. Obtaining/verifying patient anatomical information and radiation source geometry
    b. Inputting of data to planning system
6.7 Treatment Planning
    a. Manual planning and dose calculations in brachytherapy
    b. Computer assisted planning
    c. Quality control of treatment plans
6.8 Source Preparation

Sub-module 6.1: Procurement

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Capability to make budgetary requests and acquire, through a tendering process, suitable brachytherapy treatment and ancillary equipment	Demonstrates a limited understanding of the processes involved in equipment requisition and acquisition	Demonstrates a good understanding of the processes involved in equipment requisition and acquisition. Is able to review and report department needs with respect to brachytherapy equipment but makes significant errors or omissions.	Is able to accurately review and report department needs with respect to brachytherapy equipment with only a few errors or omissions. Is capable of preparing necessary documents under supervision.	Contributes to the preparation of specifications, evaluation of tenders and recommendation for brachytherapy equipment. Requires guidance with these duties.	Is capable of an independent and error free contribution to the preparation of specifications, evaluation of tenders and recommendation for acquisition of brachytherapy equipment..
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.2: Quality Assurance in Brachytherapy I – Acceptance Testing

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Development and performance of test procedures and protocols for acceptance testing of brachytherapy equipment	Demonstrates a limited understanding of test procedures and protocols for the acceptance testing of brachytherapy equipment	Demonstrates a good understanding of the test procedures and protocols for the acceptance testing of brachytherapy equipment	Able to design methods and test procedures/ protocols for a brachytherapy acceptance testing programme and to use established protocols to perform acceptance testing with supervision. Makes significant errors if unsupervised.	Able to design methods and test procedures/ protocols for a brachytherapy acceptance testing programme and to use established protocols to perform acceptance testing without close supervision. Makes only minor errors.	Able to independently perform all aspects of the acceptance testing of brachytherapy equipment to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.3: Quality Assurance in Brachytherapy II – Commissioning

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Development and performance of the test procedures and protocols for commissioning of brachytherapy equipment	Demonstrates a limited understanding of methods and procedures for commissioning brachytherapy equipment	Demonstrates a good understanding of methods, procedures and test equipment for commissioning brachytherapy equipment	Able to design methods and procedures for commissioning brachytherapy equipment with supervision. Makes significant errors if unsupervised. Can assist with the commissioning of brachytherapy equipment	Able to design methods and procedures for commissioning brachytherapy equipment and to contribute to commissioning of brachytherapy equipment without close supervision. Makes only minor errors.	Able to independently perform all aspects of commissioning of brachytherapy equipment to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.4: Quality Assurance in Brachytherapy III – Quality Control

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Design, develop and perform test procedures and protocols for QC of brachytherapy equipment	Demonstrates a limited understanding of the methods/procedures and equipment used in the quality control of brachytherapy equipment..	Demonstrates a good understanding of the methods/procedures, equipment and tolerance and action levels used in the quality control of brachytherapy equipment.	Demonstrates a good understanding of the methods/procedures, equipment and tolerance and action levels used in the quality control of brachytherapy equipment. Able to design and perform quality control tests with supervision. Makes significant errors if unsupervised.	Able to design and perform the quality control tests on brachytherapy equipment with supervision. Makes only minor errors.	Able to independently perform all aspects of quality control tests on brachytherapy equipment without supervision to an acceptable standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.5: Calibration of Brachytherapy Sources

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Understands the principles and processes in the calibration of brachytherapy sources.	Demonstrates a limited understanding of the principles and processes. Has observed but not performed the calibration of sources.	Demonstrates a good understanding of the principles and processes. Requires close supervision to ensure error free calibration of sources.	Demonstrates a good understanding of the principles and processes. Requires only limited supervision in performing a calibration. Occasionally makes significant errors.	Demonstrates a good understanding of the principles and processes and is able to perform calibration of sources unsupervised. Makes occasional minor errors which do not have clinical impact.	Demonstrates a good understanding of the principles and processes and is able to perform calibration of sources unsupervised and to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.6a: Acquisition of Image and Source Data for Treatment Planning (Obtaining/verifying patient anatomical information and radiation source geometry)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to supervise/advise on the use of imaging equipment to obtain/verify patient anatomical information and radiation source geometry for treatment planning/dose calculation	Demonstrates a limited understanding of the methods and procedures for localization and reconstruction of brachytherapy sources as well as the acquisition of relevant patient anatomical information and source geometry and dose distribution.	Demonstrates a good understanding of the methods and procedures for localization and reconstruction of brachytherapy sources as well as the acquisition of relevant patient anatomical information and source geometry and dose distribution. Demonstrates a limited ability to supervise or advise on acquisition of patient anatomical information and source geometry for treatment planning. Requires close supervision.	Demonstrates a good ability to supervise or advise on acquisition of patient anatomical information and source geometry for treatment planning of a limited number of sites. Requires only limited supervision.	Demonstrates a good ability to supervise or advise on acquisition of patient anatomical information and source geometry for planning of the full range of sites treated by brachytherapy.. Requires only limited supervision.	Capable of independently supervising or advising on acquisition of patient anatomical information and source geometry for planning of the full range of sites treated by brachytherapy to an acceptable clinical standard
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.6b: Acquisition of Image and Source Data for Treatment Planning (Inputting of data to planning system)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Capable of inputting patient and radiation source data to treatment planning system for planning	Demonstrates only a limited ability to input data to the planning system.	Demonstrates a good ability to input data to the planning system. However requires close supervision to ensure error free data entry.	Demonstrates a good ability to input data to the planning system. Requires only limited supervision. Occasionally makes significant errors.	Demonstrates a good ability to input data to the planning system. Requires only limited supervision. Makes occasional minor errors which do not have clinical impact.	Capable of inputting data to the planning system without supervision and to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.7a: Treatment Planning (Manual planning and dose calculations in brachytherapy)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to perform manual dose calculations in brachytherapy	Demonstrates a limited ability to perform brachytherapy treatment planning and dose calculations manually.	Demonstrates a good ability to perform brachytheapy treatment planning and dose calculations manually for some of the sites commonly treated. However requires close supervision to ensure an error free result.	Demonstrates a good ability to perform treatment planning and dose calculations manually for most sites treated using brachytherapy. Requires close supervision. Occasionally makes significant errors if unsupervised.	Demonstrates a good ability to perform treatment planning and dose calculations manually for most sites treated using brachytherapy. Requires only limited supervision. Makes occasional minor errors which do not have clinical impact.	Demonstrates a good ability to perform treatment planning and dose calculations manually most sites treated using brachytherapy to an acceptable clinical standard. without supervision
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.7b: Treatment Planning (Computer assisted planning)

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Ability to use a treatment planning computer to generate an acceptable brachytherapy treatment plan	Demonstrates a limited ability to use a planning computer to generate acceptable brachytherapy treatment plans and dose calculations.	Demonstrates a good ability to use a planning computer to generate acceptable brachytherapy treatment plans and dose calculations for some of the sites commonly treated. However requires close supervision to ensure an error free result.	Demonstrates a good ability to use a planning computer to generate acceptable treatment plans and dose calculations for most sites treated using brachytherapy. Requires close supervision. Occasionally makes significant errors if unsupervised.	Demonstrates a good ability to use a planning computer to generate acceptable treatment plans and dose calculations for most sites treated using brachytherapy. Requires only limited supervision. Makes occasional minor errors which do not have clinical impact.	Demonstrates a good ability to use a planning computer to generate acceptable treatment plans and dose calculations for most sites treated using brachytherapy.to an acceptable clinical standard. without supervision
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.7c: Treatment Planning (Quality control of treatment plans)

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to perform QC of individual treatment plans	Demonstrates a limited understanding of the requirements for QC of individual brachytherapy treatment plans.	Demonstrates a good understanding of the requirements for QC of individual brachytherapy treatment plans. Able to check treatment plans with supervision.	Able to check brachytherapy treatment plans without close supervision but makes occasional significant errors. Able to prepare appropriate QC or phantom plans for dosimetry verification with supervision.	Able to check treatment plans and to prepare appropriate QC or phantom plans for dosimetry verification without close supervision. Makes only minor errors.	Able to independently perform all aspects of the QC of individual treatment plans to an acceptable clinical standard.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 6: BRACHYTHERAPY (cont'd)

Sub-module 6.8: Source Preparation

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Safe handling of brachytherapy sources and preparation of treatment applicators	Demonstrates only a limited understanding of the principles and procedures for safe handling and preparation of brachytherapy sources.	Demonstrates a good understanding of the principles and procedures for safe handling and preparation of brachytherapy sources. Able to prepare sources for manual and/or afterloading treatments. Requires close supervision.	Able to prepare and load sources for manual and/or afterloading treatments. Capable of performing QC of source loading. Requires close supervision.	Able to prepare and load sources for manual and/or afterloading treatments. Capable of performing QC of source loading. Makes occasional minor errors.	Demonstrates the ability to accept independent responsibility for the preparation and loading of sealed sources.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT

Sub-modules

7.1 Professional Awareness
7.2 Communication
7.3 General Management
7.4 Information Technology
7.5 Quality Management Systems
7.6 Quality Management for the Implementation of New Equipment

Sub-module 7.1: Professional Awareness

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Professional awareness	Demonstrates only a limited awareness of relevant professional issues .	Demonstrates a good awareness of most relevant professional issues.	Demonstrates a good awareness of relevant professional issues. Occasionally participates in professional body activities.	Demonstrates a good awareness of relevant professional issues. Frequently participates in professional body activities.	Demonstrates a good awareness of relevant professional issues. Contributes to professional body activities.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT (cont'd)

Sub-module 7.2: Communication

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Oral and written communication, and interpretation skills.	Demonstrates only limited oral and written communication skills.	Generally demonstrates clear and concise expression orally and in written forms.	Generally demonstrates clear and concise expression orally and in written forms. Has limited experience in preparing and presenting a scientific seminar. Developing the ability to write in a scientific manner.	Consistently demonstrates clear and concise expression orally and in written forms. Capable of presenting a scientific seminar and preparing a scientific manuscript with assistance.	Has well developed oral and written communication skills. Capable of presenting a scientific seminar and preparing a scientific manuscript without errors without assistance.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT (cont'd)

Sub-module 7.3: General Management

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Appropriate level of management skills.	Demonstrates a basic understanding of management skills.	Demonstrates a good understanding of management skills.	Demonstrates a good understanding of management skills however has only a limited ability to utilise such skills.	Demonstrates a good understanding of management skills and. generally utilises those skills effectively.	Demonstrates an excellent understanding of management skills and consistently utilises those skills effectively.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT (cont'd)

Sub-module 7.4: Information Technology

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Knowledge and basic skills in Information Technology.	Demonstrates a basic capability with routine use of personal computers.	Demonstrates a good capability with routine use of personal computers. Has limited ability with more advanced aspects of IT such as interfacing, electronic communication standards, PACS	Demonstrates an advanced level of capability with personal computers and has a good ability with more advanced aspects of IT	Demonstrates an excellent level of capability in the more advanced aspects of IT and is able to identify many of the professional issues related to electronic media, such as licences, levels of access and confidentiality.	Demonstrates an excellent level of capability in the more advanced aspects of IT and is able to relate professional issues related to electronic media to the radiotherapy department.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT (cont'd)

Sub-module 7.5: Quality Management Systems

Criterion/Competency	Level of Competency Achieved				
	5	4	3	2	1
Competent in designing the structure of a quality management system	Demonstrates a basic understanding of the relevant terms and the role of quality management in radiation therapy.	Demonstrates a good understanding of the relevant terms and the role of quality management in radiation therapy.	Understands key elements of a quality management system and is able to design the structure of a quality manual and apply it to a representative selection of items. Requires significant guidance.	Understands key elements of a quality management system and is able to design the structure of a quality manual and apply it to a representative selection of items. Requires only minor guidance.	Understands key elements of a quality management system and is able to independently design the structure of a quality manual and apply it to a representative selection of items.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 7: PROFESSIONAL STUDIES AND QUALITY MANAGEMENT (cont'd)

Sub-module 7.6: Quality Management for the Implementation of New Equipment

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Competent in designing and performing a quality assurance programme required for the clinical implementation of new equipment	Demonstrates a basic understanding of the generic steps required for the clinical implementation of new equipment	Demonstrates a good understanding of the steps required for the clinical implementation of new equipment. Capable of implementing/ commissioning at least one radiation facility with supervision.	Demonstrates a good understanding of the steps required for the clinical implementation of new equipment. Capable of implementing/ commissioning several radiation facilities with supervision.	Capable of implementing/commissioning several radiation facilities without supervision. Makes only minor errors which do not have clinical impact.	Capable of implementing/commissioning most radiation facilities to an acceptable clinical standard without supervision
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

MODULE 8: RESEARCH, DEVELOPMENT AND TEACHING

Sub-modules
8.1 Research and Development
8.2 Teaching

Sub-module 8.1: Research and Development

Criterion/Competency	**Level of Competency Achieved**				
	5	**4**	**3**	**2**	**1**
Ability to carry out research and development in Radiation Oncology Physics and instrumentation either individually or as a member of a team	Capable of assisting in a research or development project. Requires significant guidance.	Is capable of contributing to a R&D project. Requires significant guidance.	Able to perform or to contribute to a R&D project without direct supervision.	Demonstrates a good level of ability for independent research. Requires only minor guidance	Demonstrates a good level of ability for independent research without guidance.
Date Achieved					
Supervisor's Initials					

Date	**Supervisor's comments (referring to assessment criteria & recommended items of training).**

MODULE 8: RESEARCH, DEVELOPMENT AND TEACHING (cont'd)

Sub-module 8.2: Teaching

Criterion/Competency	Level of Competency Achieved				
	5	**4**	**3**	**2**	**1**
Ability to teach radiation and general physics.	Understands the general requirements for effective teaching. Demonstrates a limited ability to prepare and deliver appropriate short (1-2 hours) courses. Requires guidance.	Demonstrates a good ability to prepare and deliver appropriate short courses without significant guidance.	Demonstrates a good ability to prepare and deliver more comprehensive courses for which the content has been defined.	Demonstrates the ability to decide on content and to develop and deliver a high quality course.	Is capable of effectively teaching and mentoring other professionals in the areas of general, radiation and radiation oncology physics.
Date Achieved					
Supervisor's Initials					

Date	Supervisor's comments (referring to assessment criteria & recommended items of training).

APPENDIX II. SUPPLEMENTARY FORMS AND DOCUMENTS

APPLICATION

FOR ENTRY AS A RESIDENT TO THE

CLINICAL TRAINING PROGRAMME

in

RADIATION ONCOLOGY MEDICAL PHYSICS

ADMINISTERED BY

Family Name: .....**Given Names**:.....…….
(In BLOCK letters) (In BLOCK letters.)
Please highlight the name you prefer to be called by.

Please tick appropriate box

☐ **Ms**

☐ **Mr**

Personal Details of Applicant
(please complete all details In BLOCK letters)

Address:

.....

.....

Postcode: .....

Telephone Number: ..... Fax: ……

Email: ……..

Previous Academic Record
A copy of the degree(s) and/or transcript(s) of the academic record in the original language (and English translation if not in English) must be attached to this application and forwarded to the National Programme Coordinator.

Undergraduate Education:

Name of Institution: .....….

Address of Institution: …….....

Year commenced: ……. Year Completed: …….

Name of degree obtained: ……
Majoring in: …….

Post Graduate Education in Medical Physics:

Name of Institution: .....….

Address of Institution: …….

Year Commenced: ……. Year Completed: …….

Name of Degree Obtained: ……..……
Majoring in:…….

Other Post Graduate Education:

Name of Institution: .....

Address of Institution: ……

Year Commenced: ……. Year Completed: ……

Name of Degree Obtained: ……..……..……
Majoring in:…….

Attach additional pages if required.

To be signed by The National Programme Coordinator:

I have sighted the applicant's degree(s) and/or transcript(s) of their academic record in the original language (and English translation if not in English). These qualifications are appropriate for the applicant to enter the Clinical Training Programme for Radiation Oncology Medical Physicists in (insert name of member state).

Signed:……. Date: ……/……/……..

National Programme Coordinator for (insert name of member state).

Training Program Details

In-Service Clinical Training Position:

Name of Clinical Department: ……...

Address of Clinical Department: ……

…….

…… Postcode: .....

Chief Physicist[3]: ……

Telephone Number: ..... Fax Number: .....

Email: ……..

Clinical Supervisor (if known): ……

Telephone Number: ..... Fax Number: .....

Email: ……..

Employment details of Resident

Date Commenced/Commencing: ……..

Full or Part Time: ……

☐ Permanent ☐ Temporary

If temporary please state duration: ……

To be signed on behalf of the employer[1]:

I certify that the applicant has been accepted for an In-Service Clinical Training Position in this department and that the details of the In-Service Clinical Training Position provided above are correct.

Endorsed by:…… Date: ……/……/……..
(signed on behalf of the employer)

Name in BLOCK letters ……..

This refers to the person who is overall responsible for the medical physics service in which the resident is being trained.

Position (example Head of Department)……..

Statement by the Applicant

I hereby apply to undertake the Clinical Training Programme in Radiation Oncology Medical Physics.

I agree that the statements made by me in this application are correct to the best of my knowledge.

APPLICANT'S SIGNATURE:…… DATE: …….

Instructions to the Applicant

Please ensure that:

- *a copy of your **degree(s) and/or transcript(s) of your academic record** in the original language (and English translation if not in English) is attached to this application form*, *and*
- *the Head of Department or other appropriate authority has signed the **"Training Programme Details"** section (confirming that you have been accepted into a clinical training position).*

This application should be sent by either post or email to the National Programme Coordinator. Electronic signatures are acceptable

You will be advised of the outcome of your application.

Contact details for the National Programme Coordinator

Insert contact details for NPC

WORK PLAN AGREEMENT

FOR _____(insert name of Resident)

FOR THE SIX MONTH PERIOD from _____/____/_____ to ____/____/____

Month Specify e.g. Jan	**Sub-modules to be worked on**	**Pre-requisite knowledge to be acquired by (date)**	**Competency assessment schedule (date)**	**Resources/strategies (if necessary use notes section below)**
1.				
2.				
3.				

Learning agreement (cont'd)

Month Specify e.g. Jan	Sub-modules to be worked on	Pre-requisite knowledge to be acquired by (date)	Competency assessment schedule (date)	Resources/strategies (if necessary use notes section below)
4.				
5.				
6.				

LEARNING AGREEMENT (CONT'D)

RESOURCES AND STRATEGIES

Notes: _____

_____

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SIGNED:

_____ (Resident)

_____ (Clinical Supervisor)

SUMMARY OF SCHEDULE FOR COMPLETION OF CLINICAL TRAINING PROGRAMME

Level of competency to be obtained and assessed by end of period specified.

SUB-MODULE/ COMPETENCY	**Year of Training Specify e.g. 2008**						
	1		2		3		4
	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June
1.1							
1.2							
1.3							
1.4							
2.1							
2.2							
2.3							
2.4a							
2.4b							
2.4c							
2.5							
2.6							
2.7							
2.8							
2.9							
3.1							
3.2							
3.3							
3.4							
3.5							
3.6							

SUMMARY OF SCHEDULE FOR COMPLETION OF CLINICAL TRAINING PROGRAMME (cont'd)
Level of competency to be obtained and assessed by end of period specified

SUB-MODULE/ COMPETENCY	Year of Training Specify e.g. 2008						
	1 _____		2 _____		3 _____		4 _____
	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June
4.1							
4.2							
4.3a							
4.3b							
4,3c							
4.4a							
4.4b							
4,4c							
4.5a							
4.5b							
4,5c							
4.6							
4.7							
4.8a							
4.8b							
5.1							
5.2a							
5.2b							
5.2c							
5.3							
5.4a							
5.4b							
5.5a							

SUMMARY OF SCHEDULE FOR COMPLETION OF CLINICAL TRAINING PROGRAMME (cont'd)

Level of competency to be obtained and assessed by end of period specified

SUB-MODULE/ COMPETENCY	Year of Training Specify e.g. 2008						
	1 _____		2 _____		3 _____		4 _____
	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June
5.5b							
5.5c							
5.5d							
6.1							
6.2							
6.3							
6.4							
6.5							
6.6a							
6.6b							
6.7a							
6.7b							
6.8c							
6.8							
7.1							
7.2							
7.3							
7.4							
7.5							
7.6							
8.1							
8.2							

ASSIGNMENT SCHEDULE

	Year of Training Specify e.g. 2008					
	1 _____		2 _____		3 _____	
	Jan-June	July-Dec	Jan-June	July-Dec	Jan-June	July-Dec
ASSIGNMENT 1.						
Topic selected						
Assignment submitted						
Assessed as satisfactory						
ASSIGNMENT 2.						
Topic selected						
Assignment submitted						
Assessed as satisfactory						
ASSIGNMENT 3.						
Topic selected						
Assignment submitted						
Assessed as satisfactory						

6 MONTH PROGRESS REPORT FORM

Resident: _____ Clinical Supervisor: _____

(insert names in BLOCK LETTERS)

Date of this Report: ____/____/____
Date of Commencement in the Training Programme: ____/____/____

The Report is an opportunity for you and your Clinical Supervisor to assess how your clinical training has progressed over the past 6 months, to re-formulate your work plan for the next 6 months, to revise your schedule for completion (if necessary), and to review all aspects of your Residency. It is expected that your Clinical Supervisor will read and discuss this progress report with you.

It is particularly important that you report any obstacles to progress (lack of access to equipment, illness, etc.) and that your Clinical Supervisor indicates actions taken to address the issues (where appropriate).

SUMMARY OF PROGRESS IN THIS 6 MONTH PERIOD
(to be completed by the Resident)

Sub-modules worked on Competency level achieved (if assessment conducted)													
Sub-modules worked on													
Competency level achieved (if assessment conducted)													
Scheduled assignment submitted (yes/no/not applicable)													
Scheduled sample for logbook prepared (yes/no/not applicable)													
Other (e.g. seminar presentation, research project)													

DEVELOPMENT OF PROFESSIONAL ATTRIBUTES
(to be completed by the Clinical Supervisor).

Generic Skill	Indicate your assessment of the Resident's capabilities in relation to the following professional attributes. Is there evidence of development or acquisition of this skill in the Resident's Logbook?
Communication	
Initiative	
Motivation	
Problem Solving	
Safe work practice	
Teamwork	
Technical skills	
Time management	
Up-dates knowledge	

STATEMENT BY CLINICAL SUPERVISOR

I have discussed the attached summary of progress in this reporting period with the Resident and believe that it reflects the progress made in the past six months. The status of this Resident's Clinical Training Programme is considered to be

☐ **Satisfactory** (The Resident is on schedule to complete the training programme by the agreed date)

☐ **Somewhat behind schedule: Progress has been impeded – as a result of**

A ☐ **Issues, beyond the control of the Resident, which have now been resolved,**

or

B ☐ **Issues yet to be resolved**

These issues are described in the comments section of this report which also indicates the remedial actions taken. A revised schedule for completion has been developed and agreed to by the Resident and Clinical Supervisor.

☐ **Unsatisfactory**

Issues, as indicated below, need to be resolved.

A follow-up progress report is required from the Resident in 3 months

Comments by Resident: (Attach additional pages if necessary. Please indicate any concerns/obstacles you may have experienced which have affected progress)

Comments by Clinical Supervisor: (Attach additional pages if necessary. Please comment on remedial actions proposed to address any concerns indicated by the Resident.)

Signatures:

I agree that this report provides an accurate summary of progress in the clinical training programme of the named Resident and that any remedial action necessary to address obstacles to progress have been agreed to by both the Resident and Clinical Supervisor.

Resident_____

Clinical Supervisor: _____

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Clinical training of medical physicists specializing in radiation oncology, Training Course Series, 37, IAEA, Vienna (2009). http://www-pub.iaea.org/MTCD/publications/PDF/TCS-37_web.pdf.

[2] PODGORSAK, E.B., (Ed.) Review of Radiation Oncology Physics: A Handbook for Teachers and Students, International Atomic Energy Agency, Vienna, (2005).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna (1996).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Accidental Overexposure of Radiotherapy Patients in San José, Costa Rica, IAEA, Vienna (1998). http://www-pub.iaea.org/MTCD/publications/PDF/P027_scr.pdf.

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Lessons Learned from Accidental Exposures in Radiotherapy Safety Reports Series No. 17 IAEA, Vienna (2000). http://www-pub.iaea.org/MTCD/publications/PDF/Pub1084_web.pdf.

[6] Towards Safer Radiotherapy, Place, Published.(2008) http://www.ipem.ac.uk/docimages/2329.pdf.

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Setting up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspects, IAEA, Vienna (2008). http://www-pub.iaea.org/MTCD/publications/PDF/pub1296_web.pdf.

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