MODERNISING SCIENTIFIC CAREERS

Scientist Training Programme
Work Based Training

Learning Guide

MEDICAL PHYSICS

2012/13
STP WORK BASED PROGRAMME IN MEDICAL PHYSICS

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SECTION 1: GENERAL INTRODUCTION
READERSHIP

This Scientist Training Programme (STP) Learning Guide describes the STP work based training programmes in the UK:

- Trainees, host departments and managers of services that employ healthcare science staff;
- Work based trainers, which includes all those involved in supervising, coordinating, assessing and delivering education and training;
- Academic and administrative staff within Higher Education Institutions (HEIs);
- Strategic Health Authorities (SHAs), and their successor health and education commissioning bodies;
- Those involved in Modernising Scientific Careers (MSC) accreditation events and reviews.

A glossary of terms used is provided in Appendix 1.
Introduction

1.1 Scientist Training Programme (STP) Overview

1. Healthcare science (HCS) involves the application of science, technology, engineering and mathematics to health. Good Scientific Practice (GSP) [Appendix 2] sets out the principles and values on which education and training for healthcare science are founded. It makes explicit the professional standards of behaviour and practice that must be achieved and maintained in the delivery of work activities and clinical care for all those who work in healthcare science, the public and healthcare providers.

2. GSP and the Education and Training Standards of the Health and Care Professions Council (HCPC) are the basis for all MSC training curricula which contextualise the Standards of Proficiency set down by the HCPC in a way that is accessible to the profession and the public.

3. The healthcare science workforce and services have traditionally been grouped into three broad areas called Divisions, namely: Life Sciences/Clinical Laboratory Sciences, Physical Sciences/Medical Physics and Biomedical Engineering and Physiological Sciences/Clinical Physiology Sciences. Within each Division there are a number of healthcare science specialisms. With advances in scientific technology, changes to the delivery of healthcare scientific services and the development of MSC, the boundaries between these Divisions have been shifting. MSC recognises this important change and to date has identified nine themes within healthcare science for the STP, which enables training across a total of 24 healthcare science specialisms, with curricula for additional specialisms still under development.

4. The STP is designed to provide healthcare scientist trainees with strong science-based, patient-centred clinical training in a specialist area of healthcare science. Initial rotational training provides a broad base of knowledge, skills and experience across a group of related cognate specialisms reflective of the evolving clinical and scientific changes and requirements followed by specialisation in a single HCS specialism.

5. During the STP programme the scientist trainee is supernumerary but may contribute to the clinical work of the department in which they are training to gain the required clinical experience and competence.

6. The STP is an integrated training programme combining academic study leading to the award of a specifically commissioned MSc in Clinical Science and a work based training programme. Completion of both will lead to the award of a Certificate of Completion of the Scientist Training Programme (CCSTP) by the National School of Healthcare Science (NSHCS). Graduates are then eligible to apply to the Academy for Healthcare Science for a Certificate of Attainment and will then be eligible to apply to HCPC for registration as a Clinical Scientist.

7. The MSc Clinical Science Learning Outcomes and Indicative Content, and the associated work based learning outcomes, can be found by following the link www.networks.nhs.uk/nhs-networks/msc-framework-curricula. Further details of the
MSc in Clinical Science can be found in the student handbook from the university with which each trainee is registered.

8. This Introduction to Work Based Learning provides an overview of the work-based training programme and the guidance provided by the NSHCS for users of the Online Assessment Tool (OLAT) and e-learning Portfolio. All trainees and trainers will have access to the OLAT throughout their training. In addition, *The Reference Guide for Healthcare Science Training and Education in England* will be published in autumn 2012. This will contextualise the STP within the wider MSC programme.

9. All STP trainees will be registered with the NSHCS for the duration of their training and will be allocated a National Science Training Number (NSTN). The NSHCS working through its Themed Boards provides oversight and coordination of the STP, communicates with trainees and trainers with respect to national policy and events, liaises with the work based trainers, host employers and the academic providers, reviews progress on assessments and trainee performance including OLAT/ Structured Final Assessment (SFA) and quality assurance of the work place training environment. The School overall has a responsibility to provide confidential reports in accordance with agreed governance and oversight arrangements.

10. The work based training programme has four components each underpinned by the professional practice curriculum:
   - Induction;
   - Rotational Training;
   - Elective Training;
   - Specialist Training.

11. It is anticipated that trainees will have a brief induction period in their host employing organisation prior to commencing the introduction to their MSc in Clinical Science. As the induction period may be up to 6 weeks in some departments the time should be used to begin rotational training as well as the induction period. The subsequent initial academic period is specifically designed to give an overview of the basic science and an introduction to aspects of professional practice relevant to HCS and the STP rotational training. The duration of this first university session will vary, depending on the MSc degree which is undertaken.

12. Details of the work based assessment programme can be found in Section III of this guide and also by logging onto the online assessment tool. Details of the assessment programme for the MSc in Clinical Science will usually be published in the student handbook provided by each university.

A broad overview of the STP is shown in the diagram overleaf:
Modernising Scientific Careers: Scientist Training Programme (STP):
Diagrammatic representation of employment-based, pre-registration 3 year
NHS commissioned education and training programme

Single Specialism Work Based Programme to include a 4–6 week period of Elective Training

Work Based Rotational and Specialist Training Programme

Induction

Specialism One
Specialism Two
Specialism Three
Specialism Four

Work Based Themed Rotational Programme
4 x 12 weeks

Research Methods

Year 1

Year 2

Year 3

Specialist including Research Project

Specialist including Research Project

Generic Healthcare Science

Themed Education and Training

Generic Education and Training

Specialist Education and Training

P/T MSc Clinical Science
Blended learning (incl problem based learning)
1.2 Outcomes of the work based STP

13. On successful completion of the work based STP trainees will have clinical and specialist expertise in a specific healthcare science specialism, underpinned by broader knowledge and experience within a healthcare science division or theme. They will undertake complex scientific and clinical roles, defining and choosing investigative and clinical options, and making key judgements about complex facts and clinical situations. Many will work directly with patients and all will have an impact on patient care and outcomes. They will be involved, often in lead roles, in innovation and improvement, research and development and education and training. Some will pursue explicit academic career pathways, which combine clinical practice and academic activity in research, innovation and education.

On successful completion of the work-based training programme which forms part of the MSC STP, trainees will possess the essential knowledge, skills, experience and attributes required for their role and should demonstrate:

- A systematic understanding of clinical and scientific knowledge, and a critical awareness of current problems, future developments, research and innovation in health and healthcare science practice, much of which is at, or informed by, the forefront of their professional practice in a healthcare environment;
- Clinical and scientific practice that applies knowledge, skills and experience in a healthcare setting, places the patient and the public at the centre of care prioritising patient safety and dignity and reflecting NHS/health service values and the NHS Constitution;
- Clinical, scientific and professional practice that meets the professional standards defined by GSP and the regulator (HCPC);
- Personal qualities that encompass self-management, self-awareness, acting with integrity and the ability to take responsibility for self-directed learning, reflection and action planning;
- The ability to analyse and solve problems, define and choose investigative and scientific and/or clinical options, and make key judgements about complex facts in a range of situations;
- The ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and to communicate their conclusions clearly to specialist and non-specialist audiences including patients and the public;
- The ability to be independent self-directed learners demonstrating originality in tackling and solving problems and acting autonomously in planning and implementing tasks at a professional level;
- A comprehensive understanding of the strengths, weaknesses and opportunities for further development of healthcare and healthcare science as applicable to their own clinical practice, research, innovation and service development which either directly or indirectly leads to improvements in clinical outcomes and scientific practice; alternative;
- Conceptual understanding and advanced scholarship in their specialism that enables the graduate to critically evaluate current research and innovation methodologies and develop critiques of them and, where appropriate, propose new research questions and hypotheses;
• Scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.

14. Once registered as a Clinical Scientist, a range of career development options will be available including competitive entry into Higher Specialist Scientist Training (HSST). Alternatively, others may choose to undertake further career development in post through a structured programme of Continuing Professional Development (CPD), provided by Accredited Expert Scientific Practice or pursue a clinical academic career. Clinical Scientists who successfully complete HSST, or who can demonstrate equivalence to its outcomes, will be eligible to compete for available Consultant Clinical Scientist posts.
1.3 Key Components of Work Based Training in STP

The Trainee

15. The trainee is at the centre of the STP, supported on the one hand by the national oversight role taken by the NSHCS, working closely with local quality monitoring and performance processes currently undertaken by SHAs and on the other by the day-to-day delivery of training in the workplace, facilitated by the underpinning and integrated MSC in Clinical Science programme. This Guide contains important information which will help the trainee understand how the work based programme operates and its key elements.

16. At the core of successful work based training is appropriate educational supervision, facilitation and feedback. Each trainee will be allocated to a clinical training supervisor or training officer from within the employing host department. Trainees should ensure that a planned schedule of meetings with their training officer is agreed early in training, commencing with a meeting during the first week. Conversations between trainees and trainers are confidential, unless patient safety is at risk. When the trainee is following a rotational module a trainer from the host department will act as their main contact whilst they are away from their host department.

17. The local training departments, supported by the NSHCS working with others, are responsible for ensuring that trainees have access to training opportunities to enable the achievement of the learning outcomes of the STP. In return trainees are expected to take responsibility for:

- ensuring that they fulfill their obligations to their employer and to patients (especially with regard to patient safety and confidentiality) as healthcare professionals;
- engaging as active adult learners by initiating work based assessments; contributing to learning activities; taking into account feedback received from their trainers and assessors and; giving considered and constructive feedback on their experience of their training;
- meeting the requirements of the academic MSc Clinical Science programme.

18. Critical reflection on progress and performance is an integral part of both the STP and of being a professional. Trainees should therefore regularly critically reflect on their progress and performance, enabling them to develop skills in self-evaluation and action planning.

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1 For the purposes of this document Training Officer has been used however the title may vary between departments and may be subject to a title change in England as part of developments for the whole of the professional healthcare workforce. In essence this is the person in the host department who is responsible for the training of each trainee for the duration of the 3 years.
1.4 Host Training Departments

19. The third key component for successful training in the STP is the employing host department and other service units facilitating work based training. The success of the training and the trainee experience requires the commitment and enthusiasm of those in the work base who provide the training.

20. Host departments should therefore ensure that they are fully familiar with the four components of the work based training programme, namely: induction, rotational, elective and specialist; the underpinning professional practice curriculum and be aware of how the academic MSc in Clinical Science degree integrates with work based training.

21. All trainees must have a designated training officer who will have responsibility for:

- provision of support, guidance and mentoring for the duration of the programme, in the host department and related training environments;
- provision of a timetable which enables an appropriate balance of work and learning for the trainee;
- ensuring adequate support during periods of training outside the host department;
- ensuring that the programme of work based assessment is understood and that its outcomes for individual trainees is documented through the use of OLAT;
- ensuring that the e-learning Portfolio is discussed with the trainee and that there is clarity and agreement about its use;
- ensuring that clinical practice is well supervised for the safety of patients and the trainee, so that the acquisition of clinical competence is facilitated;
- ensuring that other contributors to the assessment process are fully aware of the requirements and the use of the OLAT.

Organisation of the Training Programme

22. The host department is responsible for organising the training programme for each of its trainees. This may involve liaising with other departments to facilitate necessary work based learning and other contributors to the associated assessment requirements. Whilst the NSHCS will provide support, host departments need to be satisfied that they are providing a training environment of appropriate quality including appropriately trained staff and facilities. Furthermore, host departments are required to engage in the quality assessment management process established by the NSHCS and provide information as necessary to enable the NSHCS to fulfil this critical function. Details of the NSHCS quality assessment management policy for work based training provider departments can be found at: www.nshcs.org.uk.
23. Induction

At the start of the STP training programme and of each new placement, trainees should be provided with an induction programme explaining trust and departmental arrangements. Initial work based induction in the host department should include an overview of the:

- hospital/healthcare setting and local policies including health and safety, confidentiality, data protection etc relevant to the placement;
- range of services provided by the department;
- range of people who use the services provided by the department;
- function, operation and routine and corrective maintenance requirements of equipment appropriate to the section(s) of the department in which the trainee will be working.

Moreover, the host department should ensure that the trainee has access to:

- Host Trust IT systems including the library and knowledge service as necessary;
- On-line Assessment and Personal Management System.

Induction should include an early discussion (within the first week) between the trainee and his/her training officer so that the curriculum, assessment and placement arrangements can be discussed. In addition, trainers should provide trainees with copies of:

- Good Scientific Practice;
- The STP work based Learning Guide;
- The OLAT learning guide;
- Links to the NSHCS (see section III for details of the role of the NSHCS in relation to STP training).

24. Rotational Training

During rotational training each trainee will undertake four rotations which will include a rotation in the area in which they will subsequently specialise. Trainees must successfully achieve all of the learning outcomes. Each rotational placement should be of approximately 12 weeks duration. It is the responsibility of the host department to organise this rotational programme and to liaise with the trainers in the rotational placement departments on the requirements of work based training and supervision and the use of the online assessment tool. The NSHCS and the SHA MSC leads (and successors) will help to facilitate rotational placements for small specialisms or where there are local issues in respect of access to particular training elements.

The host department is responsible for setting the timetable for each of the 4 rotations, which will depend on local availability and may require some time to be spent out with your locality to ensure that the learning outcomes in totality can be achieved. In agreeing the rotational training the host department will need to consider the periods of time the trainee will be required to attend the University or undertake academic activities for the MSc within the work place.
The host department must be familiar with the content, delivery and assessment programme of the MSc in Clinical Science which the trainee is undertaking at university and ensure that the departments where the trainee is placed for rotational placements are also familiar with the expected outcomes of each period of training and are trained in the assessment methods. The training officer in the host department should maintain contact with the trainee and should liaise with the person taking overall responsibility for the trainee whilst they are undertaking the rotation. Supervision meetings between the training officer and the trainee should continue whilst they are on their rotational placements.

25. Elective Training

Each trainee must undertake elective training and successfully achieve all of the learning outcomes. The host department should agree the timing and content of the elective training period with the trainee and should then inform the NSHCS of the plans for the elective by completing the appropriate form and submitting it to the School. The aim of the elective is to facilitate a wider experience of health care and/or the practice of healthcare science in a cultural and/or clinical setting that is different from the usual training environment. This may involve health care or healthcare science in a different area of the health service and may involve study abroad or pursuit of a particular clinical or research interest. The elective period can be taken any time during the specialist training, and may comprise a single period of 4–6 weeks or a series of shorter periods of elective training. It is important that the trainee is able to express their preferences for the elective period which is designed to provide a broader experience and for these to be fully taken into consideration.

26. Specialist Training

The host department will plan the timetable for specialist training. This will usually be in a single health care science specialism (except for Gastrointestinal Physiological and Urodynamic Science who share modules in the specialist training period, and Immunogenetics and Histocompatibility who share some specialist modules with Clinical Immunology). Each trainee must successfully achieve all of the learning outcomes in the specialist training modules including, by the end of the training programme, all of the professional practice learning outcomes. If the host department itself is unable to provide the necessary work based training to enable the trainee to complete all of the required learning outcomes, it will need to arrange training in other training departments and environments.

27. Supervision

STP clinical and educational supervision should promote learning, reflective practice and support the trainee to produce action plans to address identified learning needs. It will need to ensure that the trainee learns specific skills and competencies, helping them to develop self-sufficiency and self-awareness in the ongoing acquisition of skills and knowledge. At every stage, patient safety must be paramount. Supervision will require the provision of pastoral care for some trainees. Supervision may, at times during the programme, be provided by other healthcare professionals outside of healthcare science who will be appropriately trained e.g. medical colleagues.
The first supervision meeting should be set up during the first week of the training programme. At this meeting the training officer should ensure that the trainee is undertaking an induction programme that includes the hospital and department. It is recommended that following areas should be explored and agreement reached at the first meeting with respect to the:

- expectations of the training officer and trainee;
- responsibilities of the training officer and trainee;
- boundaries between the training officer and trainee;
- confidentiality;
- frequency and duration of planned supervision meetings;
- methods of communication and responsibility for arranging meetings;
- level of support and arrangements for communications between meetings;
- models of reflection and action planning;
- record keeping;
- content of the work based training programme;
- the approach to assessment and the use of the assessment tools and the online system;
- sources of help and support.
1.5 National School of Healthcare Science (NSHCS) and the STP

28. The NSHCS provides a national coordinating and oversight function to support trainees and host departments in the delivery of training. It is responsible for:

- national recruitment into STP, enabling a transparent and robust selection of the very best science graduates;
- providing national oversight of STP trainees throughout their training by managing and monitoring their progress through the OLAT, supporting trainees in difficulty as well as co-ordinating national structured assessments both during and at the end of STP training;
- evaluation of ongoing work based assessment outcomes through the OLAT, enabling the School to benchmark training programme delivery for early identification of programme issues which may need to be addressed and resolved and reporting these as part of agreed MSC governance arrangements;
- liaising with each HEI’s MSc Clinical Science programme director to ensure the integration and coordination needed to deliver the academic and work based programmes that form the STP; liaising with MSC SHA leads (and education and quality leads in the future arrangements) on local issues and problems and their resolution;
- working closely with work place training departments and providing support as appropriate;
- organising national ‘Train the Trainer’ programmes to ensure common standards of delivery and content and recommending on-going training activities to support the continuing professional development of work based trainers.

Professional Leads in each of the scientific divisions within the NSHCS will provide help and support with respect to organising rotations and/or specialist training that might require national coordination. In order to optimise the educational benefit and value of OLAT and the e-learning Portfolio, Professional Leads will also work with and support training departments in its use.

The School can be contacted on the following email nshcs@Westmidlands.nhs.uk and at www.nshcs.org.uk.
1.6 The Structure of the Learning Frameworks

29. The work-based programme is divided into modules, with each module following a standard format. The aim and scope of the module are described followed by:

- Learning outcomes – high level descriptors of required achievements for module;
- Clinical Experiential Learning – the learning activities that will facilitate learning and achievement of stated outcomes;
- Competences – further, outcome based statements for each Learning Outcome;
- Knowledge and Understanding as APPLIED to appropriate competences.

All of the above are focused on service need, patient care/pathway and continuous service improvement.
1.7 Assessment during Work Based Training

Trainee Assessment

30. The work-based assessment is designed to promote learning, skill development and competence within the specialist healthcare context. Trainees will be able to identify areas for development and improvement.

The assessment programme is designed to enable both trainee and trainer to obtain regular feedback on progress and achievement. It aims to nurture the trainee by providing professional educational support and encouraging critical reflection and generating regular feedback about progression. The programme embeds assessment tools to enable trainees to learn and develop but also to generate evidence so that judgments about progression can be made and areas identified for trainee improvement based on supportable evidence.

The work-based education and training programme should offer a constructive environment where a trainee understands that he/she is still developing and the assessment tools are intended for use in this context. As part of each assessment, the work-base assessor will facilitate a discussion in which the trainee is encouraged to reflect on his/her performance and identify his/her strengths and areas that could be improved, setting an action plan to achieve that improvement.

31. The structure of the work based assessment programme.

There are distinct elements of the work-based assessment programme for all trainees:

- Assessment Tools, see Table 1 overleaf;
- Competency Log;
- Online Assessment and Personal Learning Management System (OLAT);
- Exit assessment – Objective Structured Final Assessment (OSFA).

Assessment Tools

32. The assessment programme utilises a range of work-based assessment tools, designed to promote continuous assessment and generate feedback throughout training. The assessment promotes student centred feedback to enable the trainee to gain skills in self-assessment. There is a requirement for each trainee to engage with the assessment process and to complete a defined number and range of assessments to successfully complete each module. These are set out in OLAT.
Table 1 Summary of the STP Work Based Assessment Tools

<table>
<thead>
<tr>
<th>Assessment Tool</th>
<th>Direct observation of practical skills (DOPS)</th>
<th>Observed clinical event (OCE)</th>
<th>Case based discussion (CbD)</th>
<th>Multi source feedback (MSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>To assess a practical skill or procedure which may include interaction with a patient. Feedback is generated, learning needs identified and an action plan generated.</td>
<td>To assess a clinical encounter.</td>
<td>To assess the trainee’s ability to apply their knowledge and understanding of an aspect of an activity for example, the underpinning science, aspects of professional practice.</td>
<td>To provide a sample of attitudes and opinions of colleagues on the performance and professional behaviour of the trainee. It helps to provide data for reflection on performance and gives useful feedback for self-evaluation.</td>
</tr>
<tr>
<td><strong>Method</strong></td>
<td>The assessor observes a practical activity and facilitates student centred feedback either during or immediately following the observation. The trainee then generates an action plan.</td>
<td>The assessor observes a clinical activity and facilitates student centred feedback either during or immediately following the observation. The trainee then generates an action plan.</td>
<td>The assessor facilitates a discussion with the trainee about a clinical case with which the trainee has been involved. This may include a report, record, result or an aspect of professional practice arising from the case. Following the discussion the trainee generates an action plan.</td>
<td>Using an on-line system the trainee gains feedback from a range of people (8–10) who work with them and the trainee also rates themselves. On completion the report generated is reviewed in a discussion between the trainee and trainer and using critical reflection an action plan generated by the trainee.</td>
</tr>
</tbody>
</table>
33. Competences

All trainees are required to provide evidence to demonstrate that they have completed each competence which should then, at the request of the trainee, be signed off by a trainer. Trainees will gain competence at their own pace, but in line with the overall delivery of the relevant modules. Each competence may link directly to a specific learning outcome and some competences may be linked to more than one learning outcome, therefore successful completion cannot be achieved until demonstrated for all learning outcomes. All of the competences are contained within a competency log within the OLAT.

Completion of the competency log is essential for progression within the programme and in order to exit from the programme. The expectation is that as the trainee progresses the competency log will demonstrate an evidence base of achievement.

34. Online Assessment and Personal Management Tool (OLAT)

The achievement of competences and all work based assessments are recorded on OLAT. OLAT is customised for each specialism and contains all the above assessment tools as well as the full list of competences for each programme and a reflective log.

NSHCS will provide trainees with the information to allow them to register on OLAT at the start of their programme. As part of their registration they must nominate their training officer, even though others may contribute during the total period of work base training to the assessment process.

Short film clips which explain the principles of the assessment process and how to use each of the assessment tools are available on OLAT.

35. Objective Structured Final Assessment

At the end of training trainees will be assessed using an Objective Structured Final Assessment (OSFAs). This is a performance based assessment used to measure trainees across a number of different stations encompassing scientific, clinical and professional practice. The NSHCS, in partnership with the professional bodies and supported by the NSHCS Themed Boards, will design and deliver the OSFA and the Academy for Healthcare Science will provide external Quality Assurance.

All trainees will have the opportunity to undertake an OSFA mid-programme to provide formative experience of this assessment.
1.8 Quality Assurance and Quality Management

Quality Assurance of work based training

36. All host and training departments are responsible for the delivery of the work based training quality standards detailed in the Learning and Development Agreement (LDA) agreed with and issued by with the local Strategic Health Authority (SHA) and their successor bodies. All host and training departments providing training for trainees on the STP must also be MSC approved and accredited.

37. MSC work-based accreditation is carried out by the NSHCS on behalf of MSC.

38. The NSHCS provides oversight of the quality management and quality control of the STP work based training environments as agreed by the appropriate MSC governance arrangements and to be maintained into the future.

39. The NSHCS works in partnership with the professional bodies through its Themed Boards and the SHAs/LETBs to deliver a robust Quality Assessment Management (QAM) programme for the work based education and training programme. This QAM programme is UK wide and independent from the direct delivery of education and training. The purposes of the QAM programme are to:

- all STP training environments are accredited to deliver work based training;
- ensure that all training settings are working to the agreed standards;
- create an open and transparent culture where issues and concerns can be raised, investigated and resolved;
- ensure that trainees receive a high quality educational experience wherever their training takes place;
- identify and share examples of good practice;
- provide evidence of the quality of work based education and training environments to those who regulate and register the profession;
- provide evidence of the high standard of work based education and training and assurance that these standards are robustly managed.

40. Details of the quality management approach is available from the NSHCS (Ref NSHCS Policy 03), in summary, the quality framework includes:

- Receipt, analysis, review and response with respect to:
  - annual self assessment progress reports from each work base;
  - trainee feedback questionnaires;
  - assessment progress reports;
  - ad hoc reporting of exceptions or changes to programmes;
  - individual work based education and training timetables for each trainee;
• A mechanism for receiving and reviewing reports with respect to the STP programme from trainees, trainers, patients or other stakeholders;
• Visit Programme including:
  o a five year rolling visit programme to each work base;
  o adhoc visits to departments as required.

41. The NSHCS monitors the progress of each trainee and provides support for trainees in difficulty (Trainees in Difficulty Ref NSHCS Policy 04). Staff in the NSHCS also regularly review the STP programmes using information from the OLAT and other sources through the Themed Boards (See NSHCS Policy 01)

42. The QAM processes, established jointly by the MSC governance arrangements involving all current SHAs and the NSHCS, do not absolve the training provider from responsibility for continuously managing and maintaining the quality of its own provision. Local training departments are responsible for ongoing quality control and local education providers should therefore ensure that a high quality education and training environment is maintained.

The following sections of this Learning Guide include an overview of the STP work based programme for the specialisms within this theme. This is followed by the Learning Frameworks for the Rotational, Elective, Specialist and Professional Practice components of the programme.

Further information can be found in Appendix 3.
SECTION 2: PROGRAMME OVERVIEW

MEDICAL PHYSICS
STP WORK BASED TRAINING PROGRAMME IN IMAGING WITH NON-IONISING RADIATION

The diagram below provides an overview of the programme each trainee in Imaging with Non-Ionising Radiation will follow:

Modernising Scientific Careers: Scientist Training Programme (STP):
Diagrammatic representation of employment based, 3-year NHS commissioned, pre-registration Education and Training programme

PROFESSIONAL PRACTICE

This module spans the whole of the 3-year training programme, underpinning both work based training and the MSc in Clinical Science.

INDUCTION COMPONENT

At the start of the training programme and of each new placement all trainees will complete an induction programme.
ROTATIONAL COMPONENT

Trainees must then successfully complete the following rotations:

<table>
<thead>
<tr>
<th>Rotation 1 (INIR)</th>
<th>Imaging with Non-Ionising Radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (IIR)</td>
<td>Imaging with Ionising Radiation</td>
</tr>
<tr>
<td>Rotation 3 (RADS)</td>
<td>Radiation Safety</td>
</tr>
<tr>
<td>Rotation 4 (RP)</td>
<td>Radiotherapy Physics</td>
</tr>
</tbody>
</table>

**Duration:** Each rotation should be of approximately 12 weeks duration.

**Order:** It is expected that the first rotation completed will be Imaging with Non-Ionising Radiation.

ELECTIVE COMPONENT

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.

SPECIALIST COMPONENT

<table>
<thead>
<tr>
<th>Module 1 (INIR1)</th>
<th>Ultrasound Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (INIR2)</td>
<td>Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>Module 3 (INIR4)</td>
<td>Exposure Measurement</td>
</tr>
<tr>
<td>Module 4 (INIR5)</td>
<td>Risk, Safety and Bioeffects</td>
</tr>
<tr>
<td>Module 5 (INIR6)</td>
<td>Diagnostic Equipment Performance</td>
</tr>
<tr>
<td>Module 6 (INIR7)</td>
<td>Emerging Technology</td>
</tr>
<tr>
<td>Module 7 (INIR8)</td>
<td>Information and Communication Technology</td>
</tr>
</tbody>
</table>

**Duration:** The work based component of the seven specialist modules should be completed during the specialist training period. The work based component of the modules can run in parallel in order to use the time and clinical contacts to best advantage.

The following sections of the learning guide contain the learning frameworks for the rotational, elective, specialist and professional practice modules.
STP WORK BASED TRAINING PROGRAMME IN IMAGING WITH IONISING RADIATION

The diagram below provides an overview of the programme each trainee in Imaging with Ionising Radiation will follow:

Modernising Scientific Careers: Scientist Training Programme (STP): Diagrammatic representation of employment based, 3-year NHS commissioned, pre-registration Education and Training programme

PROFESSIONAL PRACTICE

This module spans the whole of the 3-year training programme, underpinning both work based training and the MSc in Clinical Science.

INDUCTION COMPONENT

At the start of the training programme and of each new placement all trainees will complete an induction programme.
ROTATIONAL COMPONENT

Trainees must then successfully complete the following rotations:

<table>
<thead>
<tr>
<th>Rotation 1 (IIR)</th>
<th>Imaging with Ionising Radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (RADS)</td>
<td>Radiation Safety</td>
</tr>
<tr>
<td>Rotation 3 (RP)</td>
<td>Radiotherapy Physics</td>
</tr>
<tr>
<td>Rotation 4 (INIR)</td>
<td>Imaging with Non-Ionising Radiation</td>
</tr>
</tbody>
</table>

Duration: Each rotation should be of approximately 12 weeks duration.

Order: It is expected that the first rotation completed will be Imaging with Ionising Radiation.

ELECTIVE COMPONENT

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.

SPECIALIST COMPONENT

<table>
<thead>
<tr>
<th>Module 1 (IIR1)</th>
<th>Radionuclide Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (IIR2)</td>
<td>Non-Imaging Radionuclide Tests</td>
</tr>
<tr>
<td>Module 3 (IIR3)</td>
<td>Radionuclide Therapy</td>
</tr>
<tr>
<td>Module 4 (IIR4)</td>
<td>Radiopharmacy</td>
</tr>
<tr>
<td>Module 5 (IIR5)</td>
<td>Radiation Protection</td>
</tr>
<tr>
<td>Module 6 (IIR6)</td>
<td>Diagnostic Radiology: Equipment Performance</td>
</tr>
<tr>
<td>Module 7 (IIR7)</td>
<td>Diagnostic Radiology: Image Optimisation and Patient Dose Measurement</td>
</tr>
<tr>
<td>Module 8 (IIR8)</td>
<td>Information and Communication Technology</td>
</tr>
</tbody>
</table>

Duration: The work based component of the eight specialist modules should be completed during the specialist training period. The work based component of the modules can run in parallel in order to use the time and clinical contacts to best advantage.

The following sections of the learning guide contain the learning frameworks for the rotational, elective, specialist and professional practice modules.
STP WORK BASED TRAINING PROGRAMME IN RADIATION SAFETY

The diagram below provides an overview of the programme each trainee in Radiation Safety will follow:

Modernising Scientific Careers: Scientist Training Programme (STP): Diagrammatic representation of employment based, 3-year NHS commissioned, pre-registration Education and Training programme

<table>
<thead>
<tr>
<th>Work Based Rotational and Specialist Training Programme</th>
<th>P/T MSc Clinical Science Blended learning (task problem based learning)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Specialism Work Based Programme to include a 4 – 6 week period of Elective Training</td>
<td>Year 3</td>
</tr>
<tr>
<td><strong>MEDICAL PHYSICS: Specialisms</strong></td>
<td>Specialist including Research Project</td>
</tr>
<tr>
<td>Radiotherapy Physics</td>
<td>Year 2</td>
</tr>
<tr>
<td>Radiation Safety</td>
<td>Specialist including Research Project</td>
</tr>
<tr>
<td>Imaging with Non-Ionising Radiation</td>
<td>Research Methods</td>
</tr>
<tr>
<td>Imaging with Ionising Radiation</td>
<td>Year 1</td>
</tr>
<tr>
<td>Work Based Themed Rotational Programme</td>
<td>Theme</td>
</tr>
<tr>
<td>4 x 12 weeks</td>
<td>Generic Healthcare Science</td>
</tr>
</tbody>
</table>

PROFESSIONAL PRACTICE

This module spans the whole of the 3-year training programme, underpinning both work based training and the MSc in Clinical Science.

INDUCTION COMPONENT

At the start of the training programme and of each new placement all trainees will complete an induction programme.
ROTATIONAL COMPONENT

Trainees must then successfully complete the following rotations:

<table>
<thead>
<tr>
<th>Rotation 1 (RADS)</th>
<th>Radiation Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (RP)</td>
<td>Radiotherapy Physics</td>
</tr>
<tr>
<td>Rotation 3 (INIR)</td>
<td>Imaging with Non-Ionising Radiation</td>
</tr>
<tr>
<td>Rotation 4 (IIR)</td>
<td>Imaging with Ionising Radiation</td>
</tr>
</tbody>
</table>

**Duration:** Each rotation should be of approximately 12 weeks duration.

**Order:** It is expected that the first rotation completed will be Radiation Safety.

ELECTIVE COMPONENT

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.

SPECIALIST COMPONENT

<table>
<thead>
<tr>
<th>Module 1 (RADS1)</th>
<th>Risk Assessment and New Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (RADS2)</td>
<td>Diagnostic Radiology: Equipment Performance</td>
</tr>
<tr>
<td>Module 3 (RADS3)</td>
<td>Patient Dose Assessment and Optimisation</td>
</tr>
<tr>
<td>Module 4 (RADS4)</td>
<td>Laser and Ultraviolet Equipment</td>
</tr>
<tr>
<td>Module 5 (RADS5)</td>
<td>Non-Ionising Sources: Radiation Risks, Safety and Bioeffects</td>
</tr>
<tr>
<td>Module 6 (RADS8)</td>
<td>Assess, Audit and Interpret Radiation Dose Monitoring</td>
</tr>
<tr>
<td>Module 7 (RADS7)</td>
<td>Radiation Governance Framework</td>
</tr>
<tr>
<td>Module 8 (RADS11)</td>
<td>Information and Communication Technology</td>
</tr>
</tbody>
</table>

**Duration:** The work based component of the eight specialist modules should be completed during the specialist training period. The work based component of the modules can run in parallel in order to use the time and clinical contacts to best advantage.

The following sections of the learning guide contain the learning frameworks for the rotational, elective, specialist and professional practice modules.
STP WORK BASED TRAINING PROGRAMME IN
RADIOThERAPY PHYSICS

The diagram below provides an overview of the programme each trainee in Radiotherapy Physics will follow:

**Modernising Scientific Careers: Scientist Training Programme (STP):**
Diagrammatic representation of employment based, 3-year NHS commissioned, pre-registration Education and Training programme

---

PROFESSIONAL PRACTICE

This module spans the whole of the 3-year training programme, underpinning both work based training and the MSc in Clinical Science.

**INDUCTION COMPONENT**

At the start of the training programme and of each new placement all trainees will complete an induction programme.
ROTATIONAL COMPONENT

Trainees must then successfully complete the following rotations:

| Rotation 1 (RP) | Radiotherapy Physics |
| Rotation 2 (RADS) | Radiation Safety Physics |
| Rotation 3 (INIR) | Imaging with Non-Ionising Radiation |
| Rotation 4 (IIR) | Imaging with Ionising Radiation |

Duration: Each rotation should be of approximately 12 weeks duration.

Order: It is expected that the first rotation completed will be Radiotherapy Physics.

ELECTIVE COMPONENT

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.

SPECIALIST COMPONENT

| Module 1 (RP1) | Dosimetry and Treatment Equipment |
| Module 2 (RP2) | Treatment Planning |
| Module 3 (RT3) | Brachytherapy |
| Module 4 (RT4) | Computing Related to Radiotherapy |

Duration: The work based component of the four specialist modules should be completed during the specialist training period. The work based component of the modules can run in parallel in order to use the time and clinical contacts to best advantage.

The following sections of the learning guide contain the learning frameworks for the rotational, elective, specialist and professional practice modules.
Medical Physics

SECTION 3: ROTATIONAL LEARNING FRAMEWORKS
STP Learning Framework

This section describes the Learning Framework for the Rotational Component of work-based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

Rotational Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Medical Physics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Imaging with Non-Ionising Radiation</td>
</tr>
<tr>
<td>ROTATION</td>
<td>Imaging with Non-Ionising Radiation</td>
</tr>
</tbody>
</table>
LEARNING OUTCOMES

On successful completion of this module the trainee will:

**Ultrasound**
1. Assist with the use of harmonic imaging, contrast agents and Doppler techniques to maximise the diagnostic potential of ultrasound imaging, including determining blood flow.
2. Perform routine quality control measurements on ultrasound scanners, including general, small parts and cardiac scanners.

**Magnetic Resonance Imaging**
3. Perform routine quality control measurements on a clinical magnetic resonance scanner.
4. Discuss a range of normal and pathological images obtained using simple pulse sequences, and evaluate the effect of contrast media.

**Non-Imaging Modalities**
5. Perform measurements and record the output of a range of equipment, e.g. lasers, ultraviolet (UV) and physiotherapy ultrasound.
6. Perform the required safety and quality controls checks on a range of non-ionising, non-imaging equipment, for example lasers, UV and physiotherapy ultrasound.
7. Perform a risk assessment of a non-ionising radiation facility.

**Equipment Performance**
8. Undertake performance testing on a range of non-ionising equipment.
Emerging Modalities

9. Identify and critically appraise the mode of operation and scientific principles of a new and emerging technology, and the evidence base underpinning the technology.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe and describe a range of imaging diagnostic and therapeutic techniques using non-ionising radiation in a range of clinical applications and reflect on how this specialism contributes to patient pathways.
- Participate in a range of safety, quality control and performance checks on imaging equipment that uses non-ionising radiation.
- Undertake a risk assessment on a non-ionising radiation imaging facility.
- Critically appraise an emerging modality.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Use Doppler to determine blood flow characteristics, appropriately selecting harmonic imaging, Doppler and other techniques to maximise the diagnostic potential. | • The major applications and uses of ultrasound imaging in a range of common investigations.  
• The acquisition procedures of a range of common investigations.  
• Options available to support ultrasound diagnosis, including Doppler, harmonic imaging and contrast agents.  
• The options available to support ultrasound diagnosis, including Doppler, harmonic imaging and contrast agents.  
• Specialist uses of diagnostic ultrasound.  
• Acquisition of ultrasound in a range of common investigations. |
| 1                     | Investigate the effects of user selectable parameters such as Tune-Controlled Gain (TGC), gain, power, etc., on the viewable image. | • The effect of user’s electable parameters on the viewable image. |
| 2                     | Perform routine quality control measurements on ultrasound scanners, including general, small parts and cardiac scanners. | • Performance criteria, including remedial and suspension levels, for a range of ultrasound scanners.  
• Phantoms available for assessing ultrasound scanner performance.  
• External factors affecting image displays.  
• Quality assurance of image display systems.  
• The range of measurements and which are appropriate for measuring non-ionising radiation equipment performance. |
| 2                     | Make measurements of ultrasound power output. | • The bioeffects of ultrasound.  
• The risk factors associated with patient exposure to ultrasound. |
| 3                     | Perform routine quality control measurements on a clinical magnetic resonance scanner. | • The basic role of the major components of a magnetic resonance imaging (MRI) system.  
• UK and US MR quality procedures. |
<p>| 3                     | Undertake online and offline analysis and interpretation of the results. | • The range of measurements and which are appropriate for measuring non-ionising radiation equipment performance. |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Investigate the methods of varying the tissue contrast weighting using a contrast phantom.</td>
<td>• Distinction between acceptance, baseline and routine measurements.</td>
</tr>
<tr>
<td>4</td>
<td>Review a range of normal and pathological images obtained in one common application using simple pulse sequences.</td>
<td>• The role of imaging parameters in determining image contrast.</td>
</tr>
<tr>
<td></td>
<td>• Normal and pathological MR anatomy relevant to the common application.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Practical aspects of the patient imaging process, including health and safety, infection control, informed consent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Image weighting in the context of MRI.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Benefits that Magnetic Resonance Imaging (MRI) brings to the range of available imaging techniques.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Action and limitations of MR contract agents.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Measure and record the output of a range of equipment, e.g. lasers, UV and physiotherapy ultrasound.</td>
<td>• Use and operation of a range of common non-ionising non-imaging applications, to include lasers, Ultraviolet (UV), lithotripsy, electron microscopy (EM), etc.</td>
</tr>
<tr>
<td></td>
<td>• The physical principles behind different sources of non-ionising radiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Methods of measuring the output of lasers, UV and US equipment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The use and operation of a range of common non-ionising non-imaging applications, to include; lasers, UV, lithotripsy, therapeutic ultrasound, EM etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Safety requirements in the use of non-ionising radiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• A range of clinical applications for each technique.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The use and operation of a range of common non-ionising non-imaging applications, to include lasers, UV, lithotripsy, therapeutic ultrasound, EM, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Safety requirements in the use of non-ionising radiation.</td>
<td></td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Differences in imaging and non-imaging techniques sharing a common physical principle.</td>
</tr>
<tr>
<td>6</td>
<td>Perform safety and quality control checks on a range of equipment, e.g. lasers, UV and physiotherapy ultrasound.</td>
<td>• Safety and quality controls checks required on a range of non-ionising non-imaging equipment. • National and International standards relating to equipment safety and quality control.</td>
</tr>
<tr>
<td>6</td>
<td>Measure and analyse quantitative measurements of non-imaging equipment performance.</td>
<td>• The range of measurements and which are appropriate for measuring non-imaging equipment performance. • Principal scientific differences between imaging and non-imaging applications of non-ionising radiation.</td>
</tr>
<tr>
<td>7</td>
<td>Work safely in rooms where exposure to non-ionising radiation may present a hazard.</td>
<td>• Safe practice in the handling of sources of non-ionising radiation. • Safety issues relevant to staff and patient in relation to common non-ionising options. • Safety information that should be given to patients either before and after exposure. • Methods of exposure reduction. • The risks associated with occupational and patient exposure to non-ionising radiation.</td>
</tr>
<tr>
<td>7</td>
<td>Perform a risk assessment of a non-ionising radiation facility.</td>
<td>• Main items of legislation and sources of advice relevant to the use and exposure to non-ionising radiation, distinguishing between acts, regulations, codes of practice and guidance, and the controls available to ensure safe working practice within a non-ionising radiation facility.</td>
</tr>
<tr>
<td>8</td>
<td>Make patient exposure measurements and performance testing on a range of non-ionising equipment.</td>
<td>• Choice of test equipment used in performance measurements in non-ionising radiation. • Likely and theoretical safety issues in relation to the exposure to non-ionising radiation. • Methods of exposure reduction.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
</tbody>
</table>
| 9                     | Critically appraise an emerging modality. | • Choice of method for detecting and measuring non-ionising radiation exposure.  
• Risks and the risk factors associated with patient exposure.  
• Uncertainties in the measurement of non-ionising radiation.  
• Medical physics and the application of a chosen emerging technology.  
• Sources of information pertinent to operation and safety.  
• Mode of operation and scientific principles of new and emerging technologies.  
• Determination of exposure from the new technique.  
• Determination of the risks and benefits from new techniques and minimisation of the risks. |
STP Learning Framework

This section describes the Learning Framework for the Rotational Component of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

Rotational Module

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Medical Physics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Imaging with Ionising Radiation</td>
</tr>
<tr>
<td>ROTATION</td>
<td>Imaging with Ionising Radiation</td>
</tr>
</tbody>
</table>
## Module Title

### Imaging with IR (IIR)

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>Rotation</th>
</tr>
</thead>
</table>

### AIM
To introduce the trainee to a range of equipment and techniques used in Nuclear Medicine and Diagnostic Radiology and understand the effects of image acquisition parameters and post processing.

### SCOPE
On completion of this module the trainee will be able to operate a range of equipment for equipment performance evaluation, patient dose measurement and clinical imaging.

### LEARNING OUTCOMES

On successful completion of this module the trainee will:

**Radionuclide Imaging**
1. Demonstrate safe practice when working with sources of ionising radiation, including X-ray equipment, sealed and unsealed radioactive material.

**Non-Imaging Radionuclide Tests**
2. Assist in routine patient investigations using uptake counters, gamma spectrometers, manual and automatic beta and gamma sample counters correctly and safely, and, where possible, other equipment such as whole body counters, demonstrating patient-centred, safe practice and the effect of equipment settings and counting geometry on measured count-rates.

**Radiopharmacy**
3. Perform a range of procedures in the radiopharmacy correctly and safely, including quality assurance tests of facilities, products, equipment and radionuclide calibrators.

**Radiation Protection**
4. Handle sealed and unsealed radioactive sources safely and use safe practice when working with X-ray equipment.

**Diagnostic Radiology Equipment Performance**
5. Operate radiographic and fluoroscopic equipment for the purpose of performance testing and undertake performance tests on a basic range of X-ray equipment.

**Patient Dose Measurements**
6. Make and collate patient dose measurements, calculating patient doses for a range of examinations, including the calculation of foetal dose.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe and describe a range of common nuclear medicine scans, undertake analysis of the results and discuss with your training officer how the clinical scans contribute to the diagnosis and management of patients.
- Observe and participate in the performance of a range of non-imaging in-vivo and in-vitro tests, including measurements of volume, uptake and clearance, and discuss the evidence base underpinning these procedures with your training officer.
- Observe the routine production of radiopharmaceuticals and participate in routine quality assurance procedures within the radiopharmacy and describe the role of the radiopharmacy in patient care.
- Participate in the performance assessment of a range of common X-ray imaging equipment and discuss the evidence base underpinning these measurements with your training officer.
- Audit and calculate patient doses from a range of procedures and discuss the evidence base underpinning these calculations with your training officer.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Perform routine quality control measurements on gamma cameras, **Single-photon emission computed tomography (SPECT/Computed Tomography (CT))** scanners and **Positron emission tomography (PET)/CT** scanners if available. | • Principles of quality assurance and equipment quality control.  
• The purpose of the different types of test.  
• How to operate imaging equipment, the factors that affect dose and image quality, and the intended use of the equipment.  
• The range of suitable tests to carry out on equipment to establish safe, consistent and expected operation.  
• How to analyse data, estimate errors and perform statistical analyses.  
• The risks and consequences of poor results.  
• Current guidelines and legislative requirements for imaging equipment testing.  
• The performance and limitations of test equipment.  
• The key performance parameters for evaluation.  
• The impact of differences in performance on clinical purpose.  
• Implications for dose and image quality introduced by different equipment options.  
• Appropriate specifications for different clinical requirements.  
• How a range of common clinical scans are acquired, including planar bone, planar kidney, SPECT myocardial perfusion and PET tumour imaging.  
• Performance criteria, including remedial and suspension levels, for a broad range of imaging equipment.  
• Principles and techniques of measurement and assessment. |
<p>| 1                     | Investigate the effects of acquisition parameters and post-acquisition processing and display on planar image. This should include planar, SPECT, SPECT/CT and/or PET/CT imaging if available. |                                                                                                                                                                |
| 2                     | Establish appropriate operating conditions for sample counters, including energy calibration and choice of energy. | • The range of radionuclides, radioactivity administered and radiation dose in relation to clinical studies.                                                      |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Perform routine quality control measurements on sample counters and associated equipment, e.g. centrifuges.</td>
<td>• Correct use of associated equipment, e.g. pipettes, centrifuges, etc.</td>
</tr>
<tr>
<td>2</td>
<td>Investigate the effect on measured count-rate of factors such as energy window setting, sample volume and source–detector geometry for in-vitro and in-vivo counters.</td>
<td>• The objectives of the work involving the use of radiation.</td>
</tr>
<tr>
<td>2</td>
<td>Prepare radioactive samples and standards for counting.</td>
<td>• Current working practices within the organisation.</td>
</tr>
<tr>
<td>2</td>
<td>Assist in routine patient investigations using uptake counters, gamma spectrometers, manual and automatic beta and gamma sample counters correctly and safely, and, where possible, other equipment such as whole body counters demonstrating patient-centred, safe practice and the effect of equipment settings and counting geometry on measured count-rates.</td>
<td>• Lines of communication within the organisation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Accepted standards of working practice in the field of radiation use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The relevant health and safety regulations specific to each investigation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to communicate with patients in a way that respects their dignity, rights, privacy and confidentiality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The importance of checking patient identity, explaining the procedure to the patient and gaining informed consent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The information needs of patients, common questions and concerns of patients about investigations pre, during and post investigation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The authority level for provision of information to patients.</td>
</tr>
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<td></td>
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<td>• Process of notifying patients of the results.</td>
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<td></td>
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<td>• The relevant procedures and requirements for patient conformance.</td>
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<td>• Clinical indications for, contraindications to, risks and benefits of each investigation.</td>
</tr>
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<td></td>
<td></td>
<td>• Principles, guidance and law with respect to informed consent and trust governance procedures.</td>
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</tbody>
</table>
| 2                     | Control of infection risks pre, during and post investigations and actions taken to manage these. | • Protocols and requirements for hygiene and infection control related to the relevant range of investigations, including preparation, conduct and completion of investigation.  
• Protocol for hand washing and how effective hand washing contributes to control of infection. |
| 2                     | Analyse data from non-imaging tests to give quantitative physiological information. | • The range, purpose, principles, capabilities and limitations of technology to be evaluated.  
• Relevant performance parameters and their significance to clinical requirements.  
• The range of existing evaluation methodologies and their application to new technology.  
• Methods of measurement of image quality, acquisition, processing and display.  
• Methods of measurement of dose and the implications of the results. |
| 3                     | Measure and record air pressures in the rooms of a radiopharmacy. | • Good Manufacturing Practices (GMP) requirements and associated guidelines for standards of working environment. |
| 3                     | Perform QC testing of the Tc-99m generator eluate, including yield, radionuclide purity and chemical purity. | • Physical and chemical properties of radiopharmaceuticals used for diagnostic and therapeutic nuclear medicine.  
• How to identify and comply with relevant national and international legislation and guidelines.  
• The range of relevant standard operating procedures.  
• Radiation protection guidelines and their application including local rules, environmental permitting, RSA93 (Scotland) and associated documentation for correct handling of radioactive materials. |
<p>| 3                     | Prepare a technetium-99m radiopharmaceutical kit. | |
| 3                     | Measure the radiochemical purity of a technetium-99m labelled radiopharmaceutical. | |</p>
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</table>
| 3                    | Perform routine quality assurance measurements on a radionuclide calibrator. | • Methods for both radiation and microbial contamination monitoring.  
 • The type, nature and implications of possible contaminants.  
 • Procedures relating to operational capacity and contingency planning.  
 • Control measures applicable to prevention and removal of all types of contamination.  
 • How the mo-99/TC generator is used in radiopharmacy.  
 • The range of standard environmental monitoring tests and their purpose.  
 • The importance of physical environmental monitoring and the required testing frequency.  
 • Expected performance, limitations and calibration of equipment, including dose calibrators and isolators, and range of tests to be undertaken.  
 • Requirements for storage, handling and disposal of radioactive medicinal products.  
 • Aseptic techniques and their application.  
 • Radiation protection guidelines and their application, including local rules.  
 • *Administration of Radioactive Substances Advisory Committee (ARSAC) Diagnostic Reference Levels.*  
 • Use of appropriate diluents, limitations and consequences of over-dilution and use of unsuitable containers.  
 • The range of equipment and facilities, purpose and correct use.  
 • Corrective action to be taken in the event of spillage, breakage or contamination.  
 • Your own level of responsibility relating to each part of this standard.  
 • Methods for identifying high-risk procedures and obtaining suitable |
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|                       | Handle sealed and unsealed radioactive sources, demonstrating the application of the principles of time, distance and shielding to minimise radiation dose. | approval.  
  • Sampling and pipetting techniques.  
  • The types and quantities of radiation being used in the various locations within the organisation.  
  • Application of relevant legislation and guidance to protect patients, staff and the public in nuclear medicine and diagnostic radiology.  
  • Measures that are taken to ensure that radiation doses are as low as reasonably achievable (ALARA), with particular reference to children, and to pregnant and breast-feeding patients.  
  • Legislation and sources of advice relevant to the practice of Nuclear Medicine and Diagnostic Radiology, distinguishing between acts, regulations, codes of practice and guidance.  
  • Radiation safety information that should be given to patients following the administration of diagnostic and therapeutic radiopharmaceuticals.  
  • How to minimise contamination and decontamination procedures.  
  • The importance of Environment Agency (EA)/ Scottish Environment Protection Agency (SEPA) application and approval, and the purpose of such application.  
  • The requirements and limitations of the organisation’s certificates permitting the acquisition, storing and disposal of radioactive waste.  
  • The criteria for safe storage and disposal of radioactive materials.  
  • The requirements of various items of legislation that govern the management of radioactive materials and waste.  
  • The legislative requirements for packaging, labelling and transport of radioactive material.  
  • Methods of monitoring for radioactivity and contamination, and the
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<tr>
<td></td>
<td></td>
<td>appropriateness of each method to a given scenario.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Requirements for monitoring records of radioactive materials in store.</td>
</tr>
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<td></td>
<td></td>
<td>• Requirements for annual reporting on transfer and disposal of radioactive substances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The hazards associated with and protection measures required to work safety in a radiation area.</td>
</tr>
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<td></td>
<td></td>
<td>• Precautions that should be followed by diagnostic and therapy patients on their return home.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Contraindications to and adverse effects of performance of therapy, including allergies, medical conditions, drug interactions or previous diagnostic investigations.</td>
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<td></td>
<td></td>
<td>• Clinical features that may influence the procedure.</td>
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<td></td>
<td></td>
<td>• Specific requirements of ‘comforters and carers’.</td>
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<tr>
<td></td>
<td></td>
<td>• Range of protocols and how they may be adapted to meet patient need.</td>
</tr>
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<td></td>
<td></td>
<td>• Significance of previous results on the performance of planned procedures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Range of special needs that may require adaptation of procedure.</td>
</tr>
<tr>
<td>4,5</td>
<td>Operate a range of quality control equipment, including ionisation chambers, solid state dosimeter an electrometer and a kV meter.</td>
<td>• Choice of test equipment used in performance measurements in diagnostic radiology application of image quality indicators.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods of assessing and measuring image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Factors that affect image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Standards for image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How images are formed and displayed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods and effects of data processing compression and transfer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Image artefacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to choose and use appropriate test equipment.</td>
</tr>
<tr>
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</tbody>
</table>
| 4,5                   | Change image acquisition parameters and review the effect on the measurements made using quality control equipment. | - Factors that affect image quality and patient dose.  
- How to analyse data, estimate errors and perform statistical analysis. |
| 5                     | Undertake cross-calibration of an ionisation chamber or solid state dosimeter. | - Interpretation of quality assurance tests results and identification of required remedial actions. |
| 4,5                   | Operate a basic range of radiographic and fluoroscopic X-ray equipment under supervision and perform quality assurance tests. | - Performance criteria, including remedial and suspension levels for X-ray equipment. |
| 4,5                   | Undertake image quality tests on a radiographic or fluoroscopic system. | |
| 5                     | Measure the parameters of an automatic exposure control. | |
| 6                     | Undertake a patient dose audit and present the results, including reference to appropriate dose reference levels. | - Choice of method for measuring patient dose in Diagnostics Radiology.  
- The types of radiation involved in medical exposure.  
- Risks and the risk factors associated with patient doses.  
- The operation of the equipment or processes used to deliver radiation to the patient.  
- Equipment, procedural and patient-related factors that affect dose received.  
- The range of suitable dosimeters available and their limitations and applicability.  
- How the dosimeter works and factors that affect the response of |
<p>| 6                     | Measure the performance characteristics of a dose area product meter against a calibrated reference ionisation chamber. | |
| 6                     | Measure or calculate patient doses for a range of examinations, including the estimation of foetal dose. | |</p>
<table>
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</table>
| 6                     | Calculate the risks and the risk factors associated with patient doses. | dosimeters.  
  - The quantities used as dose descriptors.  
  - How to translate measured values of dose into other dose quantities, including effective dose.  
  - How to set and apply dose reference levels.  
  - The requirements of the applicable radiation legislation and how it is applied to X-ray patient dosimetry. |
STP Learning Framework

This section describes the Learning Framework for the **Rotational Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

Rotational Module

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<td>Medical Physics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Radiation Safety Physics</td>
</tr>
<tr>
<td>ROTATION</td>
<td>Radiation Safety Physics</td>
</tr>
</tbody>
</table>
AIM
To introduce the trainee to legislation, policies, procedures and the practical implementation of radiation safety in healthcare.

SCOPE
On completion of this module, the trainee will have undertaken a range of assessments, measurements and tests based on understanding of the requirements, standards and policy for radiation safety. They will have participated in a range of radiation measurement and audit activities, including quality assurance, the optimisation of practices and the design of new facilities.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

**New Facilities**
1. Produce a design specification for planned new facilities or services requiring a radiation risk assessment, which includes essential control features.

**Facility Safety Assessment**
2. Calibrate and test equipment that measures radiation and perform a safety assessment of a radiation facility.

**Radiation Safety Audits**
3. Undertake a simple audit of an area where radiation is used according to local standard operating procedures.

**Optimisation**
4. Use the results of patient dose audit to assess and interpret the optimisation of practices.
5. Participate in measurements of image quality and patient dose for the same practice.

**Measure Radiation Levels**
6. Select and use appropriate instruments and test equipment to measure and record levels and characteristics of radiation.

**Contingency Plans**
7. Assist in implementing safe and effective working practices in radiation areas, including response to radiation incidents and contingency planning.

**Policy and Procedures**
8. Critically appraise the content of local rules against legislative requirements for ionising and non-ionising radiation settings.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe and participate in a training process for radiation safety, discuss the presentation of radiation risks to other healthcare professionals with your training officer.
- Participate in, or review, the provision of radiation safety advice to a patient. Discuss the presentation of radiation risks to patients and members of the public with your training officer.
- Participate in, or review, the investigation of a radiation incident. Discuss root cause analysis and derivation of action plans with your training officer.
- Participate in, or review, the exercise of a contingency plan and the lessons learnt.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Undertake risk assessment for a radiation facility.</td>
<td>• Methods of risk assessment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sources and extent of hazards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hazards and their significance.</td>
</tr>
<tr>
<td>1</td>
<td>Undertake room design from first principles for a diagnostic X-ray facility and surgical laser facility.</td>
<td>• Properties of the radiation source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods of control of radiation levels in the facility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Design constraints and how to meet them by calculation and prediction.</td>
</tr>
<tr>
<td>1</td>
<td>Specify the design and control features for each of the facilities.</td>
<td>• Shielding materials and construction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Safety mechanisms and warning systems.</td>
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<td></td>
<td></td>
<td>• Planning and design for radiation safety.</td>
</tr>
<tr>
<td>1</td>
<td>In conjunction with the user develop the local rules procedures for the new facilities.</td>
<td>• Routine work undertaken within the facility.</td>
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<tr>
<td></td>
<td></td>
<td>• Application of relevant requirements of Ionising Radiation Regulations (IRR) 1999 and CAORaW.</td>
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<td>• Factors influencing safe use of the intended radiation sources and their relative significance.</td>
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<tr>
<td>2</td>
<td>Compare the design features and control systems of a facility with the specified design.</td>
<td>• Radiation characteristics of the equipment within the facility.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Characteristics of the radiation source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Radiation intensity.</td>
</tr>
<tr>
<td>2</td>
<td>Calibrate and test equipment that measures radiation and obtain measurements required and the safety features to be tested as part of the critical examination.</td>
<td>• Measurement of radiation levels and characteristics.</td>
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<tr>
<td></td>
<td></td>
<td>• Functional testing of control features and their failure modes.</td>
</tr>
<tr>
<td>2</td>
<td>Compare the results of the critical examination with relevant legislation, standards and guidance.</td>
<td>• Apply legislation and guidance relevant to new facilities.</td>
</tr>
<tr>
<td>2</td>
<td>Report findings of the critical examination and make</td>
<td>• Interpretation of compliance with legislation and guidance.</td>
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<td></td>
<td>• Reasonable foreseeable incidents and their likelihood.</td>
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<td>recommendations for improvements within specified timescale.</td>
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<tr>
<td>2</td>
<td>Confirm acceptability of radiation levels within the defined area or distance from the source.</td>
<td>• Methods of exposure control and their effectiveness.</td>
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<tr>
<td>2</td>
<td>Confirm that warning devices, interlocks and safety cut-off mechanisms are fully operational.</td>
<td>•</td>
</tr>
<tr>
<td>3</td>
<td>Assess audit reports, actions plans and outcomes against legislative requirements.</td>
<td>• The role of audit in assuring compliance with requirements for radiation safety.</td>
</tr>
</tbody>
</table>
| 3                     | Undertake a simple audit of an area where radiation is used according to local standard operating procedures. | • Framework for audit of radiation dose to patients.  
• Framework for monitoring radiation dose to staff.  
• Objective assessment of legislative requirements.  
• The role of service documentation in compliance with radiation safety.  
• Analysis of compliance and interpretation of legislation.  
• Reporting of findings commensurate with the intended audience.  
• Principles of assurance and continuous improvement. |
<p>| 3                     | Report findings; specify degree of compliance, recommendations for further action and date of follow-up review. | • Audit cycle. |
| 4                     | Participate in, or review, patient dose audit data to assess optimisation including the use of diagnostic reference levels | • Principles for optimisation of practices involving radiation. |</p>
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<tbody>
<tr>
<td>5</td>
<td>Undertake measurements to assess patient dose and image quality in a plain X-ray or fluoroscopy room.</td>
<td>• Current practices within the service involving the use of radiation. • Means of measuring, calculating and estimating representative doses to patients. • The relevant dose quantities. • Patient factors affecting dose. • Link between radiation doses and diagnostic outcomes. • Limitations of measurement devices used.</td>
</tr>
<tr>
<td>5</td>
<td>Review the outcome of image quality and patient dose measurements and recommend optimisation strategies.</td>
<td>• The influence of dose on image quality and options for clinical assessment. • Acceptable range of doses to patients. • Factors affecting radiation doses received by a range of patient groups. • The requirements of the relevant radiation legislation or guidance. • Current developments relating to reduction of dose/exposure.</td>
</tr>
<tr>
<td>6</td>
<td>Select appropriate monitor or dosemeter for the type(s) of radiation to be measured for a range of ionising and non-ionising radiation.</td>
<td>• Radiation measurement devices, their application and limitations.</td>
</tr>
<tr>
<td>6</td>
<td>Ensure selected device is in working order and within calibration.</td>
<td>• Calibration, traceability and instrument function. • Constancy testing/calibration check.</td>
</tr>
<tr>
<td>6</td>
<td>Perform the full range of measurement activities specified, using a range of recording methods.</td>
<td>• Measurement methods, dose/dose rate, quantity and units.</td>
</tr>
<tr>
<td>6</td>
<td>Record the results of measurements accurately and in correct format.</td>
<td>• Acceptable and permissible range of radiation levels. • Alternative strategies to verify findings or resolve uncertainties.</td>
</tr>
<tr>
<td>6</td>
<td>Interpret the significance of measurements and draw conclusions.</td>
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<tr>
<td>7</td>
<td>Critically appraise contingency plans within local rules.</td>
<td>• Contingency plans and their requirements.</td>
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</table>
| 7                     | Identify and plan an exercise to rehearse contingency plans (e.g. contamination incident, loss of source). | • Procedures and policies for the management and control of incidents involving radiation.  
• Practical execution of a contingency plan.  
• Training requirements. |
| 7                     | Analyse recent radiation incidents and summarise the types and causes of incidents. | • Radiation incidents, their investigation and reporting.  
• Causes and significance of radiation incidents. |
| 7                     | Participate in the investigation of a radiation incident. | • Organisational management of incidents involving radiation. |
| 8                     | Perform a critical appraisal of the content of local rules against legislative requirements for ionising and non-ionising radiation settings. | • Requirements of IRR1999 and guidance for a range of applications.  
• Organisational policies for radiation protection.  
• Procedures for management and control of radiation.  
• Understand and discuss procedures for control of equipment generating radiation and of the radiation emitted.  
• Arrangements for the control of radioactive materials for an organisation.  
• The role of policy in achieving compliance with legislation.  
• Roles and responsibilities.  
• Systems for developing and adopting policy.  
• Ionising Radiation (Medical Exposures) Regulations procedural framework for an organisation. |
## STP Learning Framework

This section describes the Learning Framework for the **Rotational Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

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<tr>
<td>ROTATION</td>
<td>Radiotherapy Physics</td>
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</tbody>
</table>
AIM
Trainees will gain an understanding of dosimetry, codes of practice, treatment machines and treatment planning, together with relevant radiation protection legislation.

SCOPE
On completion of this module the trainee will be able to plan treatment and operate a range of treatment equipment under supervision, and, through application of knowledge and understanding, select and use relevant measurement devices to undertake basic measurements on treatment machines.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

Radiation Protection applied to Radiotherapy
1. Assist with the safe handling and operation of small sealed sources.
2. Undertake a risk assessment and perform a radiation protection room survey.

Dosimetry and Treatment Equipment
3. Operate treatment equipment safely (under supervision), selecting and using relevant measurement devices, undertaking basic measurements on the treatment machines.
4. Assist with routine quality control on external beam radiotherapy equipment and evaluate the appropriateness of action/tolerance levels.

Treatment Planning
5. Assist with the treatment-planning process from immobilisation to the start of treatment and produce and critically appraise routine MV photon treatment plans.
6. Perform quality assurance checks on treatment-planning systems.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Follow a patient through the complete pathway of radiotherapy treatment and participate in the pathway processes.
- Undertake validation calculations on routine treatment plans.
- Set up equipment and undertake quality control measurements on linear accelerators.
- Participate in the calibration of treatment equipment.
- Undertake a risk assessment and room survey of a treatment room.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1                     | Assist with the safe handling and operation of small sealed sources in the department, including the performance of strontium-90 consistency checks on dosimetry equipment. | • Relevant national legislation and associated guidance.  
• Local rules, their linkage to the legislation and their relevance in the local department.  
• Safe handling and operation of small sealed sources in the department.  
• High Activity Sealed Source (HASS) sources and security issues.  
• Basic awareness of the quality system and an understanding of its relationship to legislation.  
• Concept of justification for medical radiation exposures.  
• Duty holders under IR(ME)R and defined roles under IRR99, within the department.  
• Programme of personnel and environmental monitoring. |
| 2                     | Perform a radiation protection room survey and discuss the results with your training officer. | • The sources of radiation and construction of radiotherapy equipment.  
• Performance characteristics and suitability of area survey monitoring equipment.  
• Principles of radiation protection and their application in context.  
• The As Low As Reasonably Practicable (ALARP) principle. |
| 2                     | Perform a radiation risk assessment and discuss the results with your training officer. | • Structure and requirements of a risk assessment.  
• Importance of engineering controls for risk management. |
| 3                     | Operate treatment equipment safely and evaluate the operation of the interlocks. | • Basic principles of linear accelerators and their operation.  
• The function of relevant components of the linear accelerator.  
• Relevant dosimetry chains and codes of practice.  
• Range and type of instruments for measurement and how to select to meet the identified need. |
<p>| 3                     | Select an appropriate dosemeter and measure standard output, including assessment of the | |</p>
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<td>constancy and leakage of the measurement system and its significance.</td>
<td>• Capabilities and limitations of such devices. • At least one code of practice and its application/relevance. • The dosimetric chain relating the output to the primary standards. • Beam characteristics. • The function of relevant components of the linear accelerator.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Relate standard output measurement to the relevant code of practice (MV/kV electron).</td>
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</tr>
<tr>
<td>3</td>
<td>Measure a beam profile at the depth of maximum dose and reference depth, and calculate the field size, penumbra, flatness and symmetry. Explain the differences and relate to the beam specification.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Critically evaluate the function of the ionisation chamber in the linear accelerator and its importance for correct treatment delivery.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Assist with routine quality control on external beam radiotherapy equipment (including items such as light to radiation, quality index) and evaluate the appropriateness of action/tolerance levels.</td>
<td>• Quality control of treatment machines. • How action levels are used to ensure equipment remains in tolerance and relate to the patient dose. • Relevant Institute of Physics and Engineering in Medicine (IPEM) reports.</td>
</tr>
<tr>
<td>5</td>
<td>Assess available immobilisation techniques and identify treatment sites that would most benefit.</td>
<td>• International, national and local guidelines in treatment planning. • How the legislation and guidance particular to treatment planning, e.g. data protection, patient confidentiality, and Ionising Radiation (Medical Exposures) Regulations 2000 fit in with local practice.</td>
</tr>
<tr>
<td>5</td>
<td>Import images for treatment-planning purposes. Evaluate the</td>
<td></td>
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<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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<td></td>
<td>interactions between data systems and be able to critically assess the essential information, e.g. image quality assurance, slice requirements, etc.</td>
<td>• How to identify and comply with relevant international and national recommendations, IR(ME)R, Caldecott principles, ICRU guidelines.</td>
</tr>
<tr>
<td>5</td>
<td>Generate outlines for anatomical structures and geometrical volumes to aid planning based on Computed Tomography (CT) data sets.</td>
<td>• Use of imaging data for the treatment-planning process.</td>
</tr>
<tr>
<td></td>
<td>Design treatment plans for two to four field treatments for a range of sites in accordance with International Commission on Radiation Units and Measurements (ICRU) Guidance and local clinical protocols (explain choice of modality/energy, beam arrangement, and compensation).</td>
<td>• Relevant departmental protocols and policies and their application with respect to dose prescription.</td>
</tr>
<tr>
<td>5</td>
<td>Appraise treatment plans, making use of dose volume information and dose constraints for organs at risk and the target volume.</td>
<td>• Local protocols for data entry, utilisation and transfer.</td>
</tr>
<tr>
<td></td>
<td>Produce a range of routine MV photon treatment plans.</td>
<td>• Basic understanding of sectional anatomy.</td>
</tr>
<tr>
<td>5</td>
<td>Perform manual calculations for basic treatment techniques, taking into account field size, wedge</td>
<td>• Relative merits of treating with photons or electrons in clinical situations.</td>
</tr>
<tr>
<td></td>
<td>Use of calculation data and charts.</td>
<td>• How to prepare the relevant patient data and patient treatment-related data in a form appropriate for calculation.</td>
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</table>

STP_LG Medical Physics 2012-13 Final Version (4.0)
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<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</thead>
</table>
| factor, change of FSD, off-axis, etc. | Perform and discuss routine quality assurance checks on the treatment planning/VSim system and the radiotherapy network. | • Range and extent of independent checks required.  
• National or international guidelines according to local practice, e.g. IPEM81. |
Medical Physics

SECTION 4: PROFESSIONAL PRACTICE LEARNING FRAMEWORK
STP Learning Framework

This section describes the Learning Framework for the **Professional Practice Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence, and Applied Knowledge and Understanding. This module spans the Rotational and Specialist period of training. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

<table>
<thead>
<tr>
<th>PROFESSIONAL PRACTICE</th>
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<tbody>
<tr>
<td><strong>DIVISION</strong></td>
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<tr>
<td>Life Sciences, Physiological Sciences, Physical Sciences and Biomedical Engineering</td>
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<tr>
<td><strong>THEME</strong></td>
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<tr>
<td>ALL</td>
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<tr>
<td><strong>SPECIALISM</strong></td>
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<td>ALL</td>
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</table>
Introduction

Good Scientific Practice (GSP) sets out the principles and values on which good practice undertaken by the Healthcare Science workforce is founded. GSP sets out for the profession and the public the standards of behaviour and practice that must be achieved and maintained in the delivery of work activities and the provision of care. GSP uses as a benchmark the Health Professions Council (HPC) Standards of Proficiency and Standards of Conduct, Performance and Ethics, but expresses these in the context of the modalities within Healthcare Science.

Good Scientific Practice represents standards and values that apply throughout an individual's career in Healthcare Science at any level of practice. Therefore the standards have been contextualised for the role of healthcare scientist. There will, however, always be a requirement for an individual to work within the limits of their scope of practice and competence.

Professional Practice in the STP Training Programme

This generic professional practice module, which all STP trainees have to complete, defines the knowledge, skills and experience that each trainee is expected to gain and apply during the STP programme and develop in subsequent employment. The degree to which each specialism applies the knowledge, skills and experience will vary, but this module sets the baseline for all trainees. Each rotational and specialist learning framework then develops areas as appropriate, for example clinical history taking in patient-facing specialisms.

While it is expected that trainees will be able to achieve the majority of the learning outcomes and competences within their specialism, some specialisms may have to make special arrangements to ensure all trainees achieve the learning outcomes and competences defined in this learning framework. For example, to work with a local clinical skills laboratory to help trainees develop basic skills in history taking.

The Learning Framework that defines the learning outcomes, clinical experiential learning, competences, and knowledge and understanding are contained on the following pages.
AIM

Professional Practice is part of the generic curriculum (applicable to all trainees) on the Scientist Training Programme. The overall aim of the module is to ensure that each trainee has the underpinning knowledge and applies this and the accompanying skills and attitudes to work as a healthcare scientist in accordance with Good Scientific Practice (GSP).

SCOPE

GSP sets out the principles and values on which the practice of Healthcare Science is undertaken. It sets out for the profession and the public the standards of behaviour and practice that must be achieved and maintained in the delivery of work activities and the provision of care. This module encompasses the knowledge, skills, experience and attitudes across four of the five domains of Good Scientific Practice, namely Professional Practice, Scientific Practice, Clinical Practice, Research and Development, and Clinical Leadership, but all other modules within this programme will contribute to embedding professional practice at the centre of the work of each trainee.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

Professional Practice

1. Place the patient at the centre of care in daily practice, ensuring the needs of patients are respected.
2. Communicate with patients, relatives, service users, other healthcare professionals, colleagues and the public with respect, empathy and sensitivity, including listening, speaking, giving and receiving information, giving and receiving feedback.
4. Demonstrate a commitment to the continuing professional development of themselves and others, and attend professional meetings.

Clinical Practice

5. Make appropriate and effective use of information and communication technology.
6. Under supervision, obtain a patient history from a normal volunteer or typical patient referred to your service and present the findings to a colleague or peer in order to understand the clinical decision-making process in clinical practice.
7. Promote the importance of patient safety and general health, safety and security in the workplace, including infection control and information governance.

Research, Development and Innovation

8. Apply knowledge, skills and experience of research, development and innovation appropriate to the role in order to identify effectively actions that will improve service provision.
9. Engage in evidence-based practice, participate in audit procedures and critically search for, appraise and identify innovative approaches to practice and delivery.

Clinical Leadership

10. Demonstrate a range of leadership skills required of an emerging leader within Healthcare Science.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Attend clinics, ward rounds, treatment and/or rehabilitation sessions, etc., in primary or secondary care, or in the charity or voluntary sector where patients attend, and observe how patient–professional relationships are developed and maintained, and reflect on how the following impact on the patient–professional relationship:
  - response to illness
  - patient and carer perspective
  - health belief models
  - diversity of the patient experience
  - disability, including learning disabilities
  - potential health inequalities
  - self-care
  - impact of life-threatening and critical conditions
  - patient involvement in decisions regarding their healthcare.
- Observe a current screening programme in the workplace and discuss the principles and practice of screening programmes in healthcare as a means of reducing disease burden with your training officer.
- Observe and participate in internally and externally accredited quality management systems and critically appraise both in your area of practice.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</thead>
<tbody>
<tr>
<td><strong>Professional Practice</strong></td>
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</tbody>
</table>
| **1** | Treat each patient as an individual, respecting their dignity and confidentiality and upholding the rights, values and autonomy of every service user. | • NHS Constitution.  
• Patient-centred care and the patient carer perspective with respect to:  
  • response to illness  
  • patient and carer perspective  
  • health belief models  
  • diversity of the patient experience  
  • disability, including learning disabilities  
  • potential health inequalities  
  • self-care  
  • impact of life-threatening and critical conditions  
  • patient involvement in decisions regarding their healthcare.  
• Local guidelines for responding to unacceptable behaviour by patients, carers, relatives, peers and colleagues, including harassment, bullying and violent behaviour. |
| **1** | Discuss personal values, principles and assumptions, emotions and prejudices, and how these may influence personal judgement and behaviour, and identify how you will practise in accordance with Good Scientific Practice. | • Good Scientific Practice.  
• The importance of maintaining own health. |
| **2** | Communicate effectively with the public, services users and other healthcare | • The principles of effective communication including:  
  • written and electronic, verbal and non-verbal and feedback  
  • the way effective communication can assist in identifying problems accurately, |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</thead>
</table>
|                       | professionals, adapting communication style and language to meet the needs of listeners. | increase patient satisfaction, enhance treatment adherence, and reduce patient distress and anxiety  
• the importance of some key ideas, for example signposting, listening, language, non-verbal behaviour, ideas, beliefs, concerns, expectations and summarising in communication  
• the range of question types that can be used in a communication. |
| 2                     | Give and receive feedback sensitively to or from a peer or colleague. |  
• The range of feedback models for giving and receiving feedback.  
• The evidence base underpinning the importance of effective feedback/feedback models. |
| 2                     | Obtain, analyse and act on feedback from a variety of sources and use it to consider personal impact and change behaviour. |  
• How to analyse feedback and frameworks for action planning.  
• Behavioural change models. |
| 2                     | Present complex ideas in understandable terms in both oral and written formats. |  
• The importance of public engagement in science and its role in health and society.  
• The factors that enable scientists to communicate to specialist and non-specialist audiences.  
• Barriers to effective communication. |
| 2                     | Use effective negotiation skills, including influencing colleagues. |  
• Communication channels with/in your host department; patients and the public; your employing institution; your profession and professional body; the wider Healthcare Science community. |
| 2                     | Work constructively and effectively as a member of a multidisciplinary team. |  
• The underpinning principles of effective teamwork and working within and across professional boundaries. |
| 3                     | Comply with relevant guidance and laws, to include those relating to: |  
• Principles, guidance and law with respect to:  
• medical ethics  
• confidentiality |
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<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| • your scope of practice  
• research ethics and governance  
• patient confidentiality  
• data protection  
• equality and diversity  
• use of chaperones  
• informed consent. | • information governance  
• informed consent  
• equality and diversity  
• child protection  
• elder abuse  
• use of chaperones  
• probity  
• fitness to practise.  
• The importance of maintaining your own health. | |
| 4 Contribute to the education and training of colleagues. | • The key principles and evidence base underpinning clinical education, encompassing curriculum design, planning, delivery and assessment. | |
| 4 Take responsibility for your learning and demonstrate a commitment to continuing professional development. | • How continuous personal development can improve personal performance. | |
| 4 Meet commitments and goals in your professional practice, using a range of organisational and planning tools. | • Different methods of planning, prioritising and organising, and how they can enhance personal effectiveness. | |
| 4 Reflect on your practice and generate a reflective diary that demonstrates how you utilise the skills required of an independent learner and your commitment to your continuing professional development. | • Core theories of learning, particularly adult learning and reflective practice, and demonstrate how these are relevant to your practice as a healthcare scientist.  
• Personal values, principles and assumptions, emotions and prejudices, understanding how these may influence personal judgement and behaviour.  
• The role of critical reflection and reflective practice and the methods of reflection that can be used to maintain or improve knowledge, skills and attitudes. | |
<p>| 4 Take responsibility for | • How to horizon scan, identify and evaluate the potential role for new and |</p>
<table>
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<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td>keeping your professional and scientific knowledge and skills up to date.</td>
<td>innovative technologies and scientific advances.</td>
<td></td>
</tr>
</tbody>
</table>

| 4 | Develop an action plan based on your experiential learning and reflection on completion of the Scientist Training Programme. | • Action planning.  
• Models and frameworks for critical reflection. |

**Clinical Practice**

| 5 | Use a range of information and communication technologies within the workplace for service delivery, research, audit and innovation, including data filing and archiving:  
• word processing  
• databases  
• statistics packages  
• PowerPoint  
• internet  
• email. | • The range and application of clinical information systems used in the work base.  
• The systems in use in the work base to file and archive information and the processes for retrieval.  
• The principles underpinning identification, storage and retrieval of scientific literature for example end note/end note web.  
• The purpose of a range of NHS information systems, including the regulations in place to ensure data security and confidentiality. This may include hospital information system, linked information systems (e.g. laboratory information management system) and middleware linking equipment to information systems. |

| 6 | Under supervision, demonstrate that you can obtain and present a patient history from a normal volunteer or | • The importance of patient-centred care and how it ensures that the wishes, beliefs, concerns, expectations and needs of patients are respected.  
• Patient and carer perspective with respect to illness, disability, health inequalities and diversity of the patient experience.  
• Structured models for presenting a patient history. |
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<tr>
<th>KEY LEARNING OUTCOMES</th>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
<td>consenting patient in order to better understand the clinical decision-making process in your clinical practice.</td>
<td>• Process of patient-centred interviewing and the features of a good consultation, including Initiating the session, gathering information, building the relationship, explaining and planning, and closing the session. • Link between the patient history and examination and development of clinical investigation and management plans.</td>
</tr>
<tr>
<td>7</td>
<td>Apply current regulations with respect to patient safety and safe systems within the workplace. To include, as appropriate to scope of practice: • risk management • biological specimen handling • COSHH • RIDDOR • radioactivity • fire safety • electrical safety • moving and handling • display screen equipment • incident reporting • infection control.</td>
<td>• The importance of health and safety within the workplace, wider healthcare environment and NHS. • Principles, process and governance of risk management. • Factors influencing health, safety and security. • Current legislation, codes of practice, guidance notes and related documents. • Principles and practice of health and safety in the workplace. • The requirements of relevant local health and safety guidelines, manuals and other documents, including the underpinning legislation. • The cause of errors related to patient safety, including patient and/or sample identification.</td>
</tr>
<tr>
<td>7</td>
<td>Use clinical coding and medical terminology in accordance with stated guidance, as appropriate to</td>
<td>• The importance of the correct use of clinical coding and medical terminology in contributing to good healthcare science practice. • Information governance principles and process.</td>
</tr>
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<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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</table>
| 7                     | Keep accurate records in accordance with current guidelines and the legal framework for data security. | • Best practice recommendations for record keeping and data security.  
• The Data Protection Act and current key guidelines, and the legal framework for data security. |
| 7                     | Use, in your practice:  
• standard operating procedures  
• protocols  
• clinical guidelines. | • Standard operating procedure, protocol and guideline, and understand the purpose of and difference between each document.  
• Evidence base that underpins the use of procedures employed by the service. |
| 7                     | Continuously improve your practice through good practice in:  
• identifying common sources of error  
• identification of risk  
• reporting critical incidents. | • The desirability of monitoring performance, internal and external quality control, learning from mistakes and adopting a no-blame culture in order to ensure high standards of care and optimise patient safety.  
• The importance of honesty and effective apology in responding to errors of practice.  
• The principles and practice of risk management and the effective investigation of incidents, resulting in the identification of root causes. |
| 8,9                   | Participate in innovation, research, service development and audit activities complying with compliance with guidance and laws relating to research ethics. | • The importance of innovation across healthcare science.  
• The role of innovation in improving quality and patient care.  
• Processes to disseminate innovation, research and audit findings.  
• The role of the healthcare scientist and the potential impact of scientific research in your area of practice.  
• The role of the healthcare scientist in service developments in your area of practice.  
• Current and developing clinical practice.  
• The effectiveness of investigations, therapies, interventions and treatments and |
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<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tr>
<td></td>
<td></td>
<td>the mechanisms by which they contribute to patient care.</td>
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<td>How to horizon scan, identify and evaluate the potential role for new and innovative technologies and scientific advances.</td>
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<tr>
<td></td>
<td></td>
<td>The role of the healthcare scientist and the potential impact of scientific developments, for example health prevention, genomic medicine, diagnostics and rehabilitation.</td>
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<td>The importance of public engagement in science and its role in health and society.</td>
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<td></td>
<td></td>
<td>The legal framework relevant to informed consent and the application to clinical care, research, audit and teaching.</td>
</tr>
<tr>
<td>8,9</td>
<td>Contribute to service and quality improvement and productivity in the work base and embed evidence-based developments within routine practice.</td>
<td>How planning can actively contribute to the achievement of service goals.</td>
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<td></td>
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<td>How to measure and monitor performance against agreed targets.</td>
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<td></td>
<td></td>
<td>The current structure, management, legal framework and quality improvement structures and processes within the NHS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The current quality improvement structures and processes within the NHS and give examples of the implications for Healthcare Science.</td>
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<td></td>
<td></td>
<td>Importance of self-care and shared care as part of NHS function and the impact of life-threatening and critical conditions.</td>
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<tr>
<td></td>
<td></td>
<td>Principles and application of evidence-based practice.</td>
</tr>
<tr>
<td>8,9</td>
<td>Undertake a literature review and prepare and present to peers a critical analysis of a publication from the scientific literature.</td>
<td>How to critically analyse scientific literature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How to structure and present a critical analysis.</td>
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<tr>
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<td>Systems of referencing.</td>
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<td></td>
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<td>Reference manager software.</td>
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<tr>
<td>8,9</td>
<td>Prepare and deliver an oral scientific communication to peers at a local, national or</td>
<td>How to prepare an oral scientific communication.</td>
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<td>How to give an effective and timely oral presentation.</td>
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<td>How to respond to questioning.</td>
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<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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<td>international meeting</td>
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<tr>
<td>Clinical Leadership</td>
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<tr>
<td>10</td>
<td>Lead in your clinical role through appropriate application of;</td>
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<tr>
<td></td>
<td>• self-management</td>
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<td></td>
<td>• self-development</td>
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<td></td>
<td>• integrity</td>
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<td></td>
<td>• self-direction</td>
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<tr>
<td></td>
<td>• problem solving</td>
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<td></td>
<td>• dealing with complex issues</td>
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<td></td>
<td>• making sound judgements in the absence of complete data.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How self-awareness, self-management and self-development and acting with integrity at all times contribute to leadership.</td>
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<td></td>
<td>The use of evidence, both positive and negative to identify options in addressing challenges.</td>
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<td></td>
<td>Methods of prioritising and organising academic and work based tasks to optimise own performance.</td>
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<tr>
<td>10</td>
<td>Identify potential areas for change and accept change identified by others, working across different provider landscapes as required.</td>
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<tr>
<td></td>
<td>Structure of the NHS.</td>
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<tr>
<td></td>
<td>The need for change, working across different provider landscapes as required.</td>
<td></td>
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<td></td>
<td>Change management methodologies.</td>
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</tbody>
</table>
Medical Physics

SECTION 5: ELECTIVE LEARNING FRAMEWORK
STP Learning Framework

This section describes the Learning Framework for the **Elective** component of **Specialist** work based learning, covering the Learning Outcomes, Clinical Experiential Learning, Competence, and Applied Knowledge and Understanding. This module spans the Rotational and Specialist period of training. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

<table>
<thead>
<tr>
<th>ELECTIVE</th>
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<tbody>
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<td>DIVISION</td>
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<tr>
<td>THEME</td>
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<tr>
<td>SPECIALISM</td>
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</tbody>
</table>

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.
### AIM
The aim of the elective period is to facilitate wider experience of healthcare and/or the practice of Healthcare Science in a cultural and/or clinical setting that is different from the usual training environment. This may involve healthcare or Healthcare Science in a different area of the health service, or in pursuit of a particular clinical or research interest.

### SCOPE
The elective provides opportunities for you to:
- explore in depth areas of particular interest beyond the scope of the scientist training programme
- increase awareness of important health issues and develop an understanding of the effect of disease on communities and individuals in different cultural contexts
- explore unfamiliar scientific, social, economic or cultural areas
- become more proficient at communication with individuals from different social, cultural and ethnic backgrounds
- gain hands-on experience that might not otherwise be possible in a scientist training programme
- design and undertake a significant assignment with appropriate guidance and supervision, thereby developing personal and organisational skills
- undertake a small audit or research project in a different clinical setting
- relate your experiences to your own area of practice.

### LEARNING OUTCOMES
Learning outcomes are specific to each student: with guidance, you are expected to identify your own educational objectives and organise an elective to achieve them.

1. Agree, organise and complete a period of education and training that provides a wider experience of healthcare and/or the practice of healthcare science, and aligns with Good Scientific Practice.
2. Critically reflect on your experience in your elective and develop an action plan as part of your continuing personal and professional development.
3. Prepare a presentation and present your elective experiences to colleagues, including trainee healthcare scientists.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Produce learning outcomes for the elective training period and link these to Good Scientific Practice.</td>
<td>• Good Scientific Practice.</td>
</tr>
</tbody>
</table>
| 2                     | Write a report of your elective training that includes your learning outcomes (mapped to Good Scientific Practice), a critical reflection on your experience and an action plan. | • Report writing.  
• Critical reflection.  
• Action planning. |
| 3                     | Plan, prepare and deliver an oral presentation that describes and reflects on the learning from your elective and shows how your experience will shape your future practice. | • How to prepare an oral communication.  
• How to give an effective and timely oral presentation.  
• Use of visual aids.  
• How to respond to questioning. |
SECTION 6: SPECIALIST LEARNING FRAMEWORK IMAGING WITH NON-IONISING RADIATION
STP Learning Framework

This section describes the Learning Framework for the **Specialist Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

### Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEME</strong></td>
<td>Medical Physics</td>
</tr>
<tr>
<td><strong>SPECIALISM</strong></td>
<td>Imaging with Non-Ionising Radiation</td>
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</tbody>
</table>
# Imaging With Non-Ionising Radiation – Specialist Modules

<table>
<thead>
<tr>
<th>Module 1 (INIR1)</th>
<th>Ultrasound Imaging</th>
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<tbody>
<tr>
<td>Module 2 (INIR2)</td>
<td>Magnetic Resonance Imaging</td>
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<td>Module 7 (INIR8)</td>
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</table>
**MODULE 1**  
Ultrasound Imaging (INIR1)  

**COMPONENT**  
Specialist

**AIM**  
For the trainee to use a range of equipment and techniques in ultrasound imaging and understand the effects of image acquisition parameters.

**SCOPE**  
Ultrasound imaging equipment, including Doppler and elastography.

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**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Operate a range of ultrasound imaging equipment for quality assurance purposes.
2. Advise on equipment choice and user-selectable options, including advanced functions such as harmonic, intracavity and elastography imaging.
3. Analyse images to extract quantitative information and increase diagnostic utility.
4. Provide a scientific contribution to the interpretation and reporting of images through explaining the scientific principles that underpin image acquisition.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe a range of clinical diagnostic ultrasound examinations undertaken in patients within care pathways, including obstetrics, vascular, breast and cardiac, and discuss the clinical application, advantages/complementary features of ultrasound with respect to other modalities within each care pathway.
- Compile a portfolio of anonymised images, commenting on the typical diagnostic appearances of human anatomy and pathology under varying imaging conditions and discussing the role that artefacts play in modifying the image.
- Use a phantom/volunteer to investigate the effects of clinical settings on the image, e.g. tissue harmonic imaging (THI), compound imaging, frequency selection, PRF, TCG setting.
- Investigate the effect of user-selectable parameters on volunteers (with appropriate permission in place) or suitable phantoms and describe how to maximise the image quality.
- Note parameters used during clinical practice and compare to the theoretical ideal parameters, i.e. frequency, power output, safety indices and discuss your findings with your training supervisor.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
</table>
| 2                    | Analyse the requirements for the optimal acquisition, processing and display of clinical images. | • Effect of different machine settings on ultrasound image.  
• Requirements for ultrasound monitors, based on the monitor display standard test patterns.  
• The role of machine settings on safety indices. |
| 4                    | Make recommendations on optimal acquisition, processing and display parameters for clinical images. | • Effect of different settings on ultrasound image, requirements for ultrasound monitors, based on the monitor display standard test patterns. |
| 3                    | Use image analysis software to extract quantitative information from ultrasound images. | • Clinical data required from ultrasound images and how it is obtained. |
| 2,4                  | Explain the cause and effect of artefacts and equipment performance limitations on the interpretation of clinical images. | • Causes of artefacts in ultrasound imaging, how to avoid them and where they may be useful.  
• Advantages and disadvantages of clinical ultrasound. |
| 1,3                  | Use Doppler techniques to provide quantitative information relating to blood flow. | • Doppler theory, shortcomings of Doppler/Doppler artefacts and how to avoid/minimise their effects. Doppler angle and beam steering. |
| 2,3,4                | Interpret advanced techniques such as elastography, harmonic imaging and contrast enhancement. | • How these different modes affect the ultrasound image, power output levels and under what conditions their application is useful. |
| 2                    | Analyse the technical requirements, including transducers, for a range of clinical uses of ultrasound equipment. | • How an ultrasound image is produced.  
• What components of the ultrasound unit affect the ultrasound image.  
• How different ultrasound transducers work.  
• Electrical safety. |
| 2,4                  | Make recommendations on optimal equipment selection for each of these clinical uses. | • Why different transducers are used for different applications.  
• Underlying physical principles of the equipment for its clinical application. Safety implications of equipment selection. |
LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Explain the principles of the major pulse sequences in clinical use.
2. Optimise a range of magnetic resonance imaging (MRI) protocols.
3. Safely and effectively use MRI equipment to obtain images from test objects.
4. Use image analysis software to extract quantitative information from MR images/spectra.
5. Appraise the key issues for a range of advanced/specialist MR examinations in use at the training centre.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

• Observe a range of clinical MRI examinations undertaken in patients within care pathways, including neuro, oncology, musculoskeletal, etc., and discuss the clinical application, advantages/complementary features of Magnetic Resonance Imaging (MRI) with respect to other modalities within each care pathway.

• Compile a portfolio of anonymised images, commenting on the typical diagnostic appearances of human anatomy and pathology under varying imaging conditions and discussing the role that artefacts play in modifying the image.

• Observe a number of advanced/specialist MR examinations, including dynamic contrast-enhanced MRI, contrast-enhanced MR angiography and cardiac imaging, and discuss the clinical application of these techniques to improve the diagnosis and management within care pathways with your training supervisor.

• Attend a meeting at which the outcome of a clinical audit, research, innovation or service development is presented, and discuss with your training supervisor how evidence-based practice is implemented with respect to MRI.

• Investigate the effect of user-selectable parameters on volunteers (with appropriate permission in place) or suitable phantoms and describe how to maximise the image quality.

• Note parameters used during clinical practice and compare with the theoretical ideal parameters, i.e. Echo Time (TE)/ Repetition Time (TR)/flip angle, and discuss your findings with your training supervisor.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1,3                    | Safely operate an MR system to obtain a selection of images using different MR pulse sequences and test objects in order to obtain images demonstrating the main characteristics of the sequence. | • Commissioning process for an MRI scanner.  
• Local rules.  
• Operation of the MR system.  
• Principles and applications of the various pulse sequences.  
• Types of test objects and their applications.  
• Implications for different field strengths. |
| 1,2                    | Optimise imaging protocols for specified clinical applications. | • Principles and applications of MR pulse sequences and imaging options. |
| 4                      | Use image analysis software to obtain quantitative results from appropriate images, e.g. measure $T_2$. | • Operation of the image analysis software.  
• Limitations of the input data.  
• Accuracy and reproducibility of the quantitative results.  
Clinical/physical/physiological interpretation of results. |
| 5                      | Summarise the principles and applications of a range of advanced/specialist MR examinations, including patient set up and coil selection. | • Underlying physical principles of the advanced/specialist examinations and their clinical applications. |
| 2, 5                   | Explain the cause and effect of artefacts and equipment performance limitations on the interpretation of clinical images. | • Causes of artefacts in MR imaging, how to avoid them and where they may be useful. |
### MODULE 3 Exposure Measurement (INIR4)

<table>
<thead>
<tr>
<th>AIM</th>
<th>To ensure the trainee can appropriately measure levels of exposure and advice on safe working in areas where exposure may take place.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOPE</td>
<td>On completion of this module the trainee will have (MR) knowledge of the measurement of patient and occupational exposure to static, time-varying, RF magnetic fields and acoustic noise (US), and demonstrate knowledge of the measurement of patient exposure to ultrasound, including thermal and mechanical indices.</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. **MR/US:** identify and use appropriate measuring equipment.
2. **MR/US:** design measurement schemes to reduce uncertainty.
3. Advise colleagues and other professionals on exposure levels and safe working practice.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

**Magnetic Resonance Imaging only**
- Participate in the commissioning of a new MR facility, identifying the 3mT and 0.5mT field contours, and assessing the acoustic noise for various pulse sequences.
- Observe clinical imaging and determine how specific absorption rate (SAR) is affected by the patient’s body habitus, discussing your findings with your training supervisor.

**Ultrasound only**
- Participate in the measurement and calibration of US beam properties, discussing the implications of your finding and their patient implications with your supervisor.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</thead>
</table>
| 1, 2                  | Design and conduct a study to evaluate occupational exposure to static magnetic fields. | - Operation of MR compatible gaussmeter.  
- Calibration and certification of devices. Limits of accuracy.  
- Guidelines on exposure to static magnetic fields. |
| 3                     | Advise on the importance of entering the correct patient height and/or weight for SAR calculation. | - Operation of MR scanner.  
- Effects of pulse sequence and static magnetic field strength on Specific absorption rate (SAR). |
| 1                     | Measure the acoustic noise generated by a variety of MR pulse sequences and, if possible, different MR systems. | - Operation of MR scanner, operation of sound-level meter, dBA scale. Calibration and certification, limits of accuracy. HSE Noise at Work Regulations |
| 1                     | Identify and use appropriate measuring equipment to investigate occupational and/or patient exposure levels. | - Physical nature of EMF/ultrasound radiation, theory of detectors, occupational exposure standards (International Commission on Non-Ionizing Radiation Protection (ICNIRP), International Electrotechnical Commission (IEC), British Medical Ultrasound Society (BMUS) guidelines, etc.). |
| 1, 2                  | Assess the suitability of non-ionising radiation test equipment and phantoms. | - Principles of equipment operation.  
- Physical nature of equipment.  
- Calibration and sensitivity of measuring equipment. |
| 1, 2                  | Measure total acoustic power from diagnostic and therapy ultrasound equipment (e.g. high-intensity focused ultrasound, lithotripsy). | - Choice of test equipment used in performance measurements in non-ionising radiation.  
- Likely and theoretical safety issues in relation to the exposure to non-ionising radiation.  
- Methods of exposure reduction.  
- Choice of method for detecting and measuring non-ionising radiation exposure.  
- Risks and the risk factors associated with patient exposure.  
- Uncertainties in the measurement of non-ionising radiation. |
<p>| 1, 2                  | Measure acoustic pressure and derived intensities from continuous and pulsed ultrasound systems. |
| 1, 2                  | Undertake measurements to determine thermal and mechanical indices associated with exposure to |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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<td></td>
<td>ultrasound.</td>
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<td>3</td>
<td>Interpret and report on findings, providing advice on exposure and safe</td>
<td>• National and international safety standards in non-ionising</td>
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<tr>
<td></td>
<td>exposure levels.</td>
<td>radiation.</td>
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</table>
### MODULE 4  
**Risk, Safety and Bioeffects (INIR5)**

<table>
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<tr>
<th>COMPONENT</th>
<th>Specialist</th>
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</table>

#### AIM
To introduce the trainee to a range of equipment, techniques and exposure measurements.

#### SCOPE
On completion of this module the trainee will understand the risks and control measures in the design of a non ionising radiation facility: the risks and control measures in the operation of a non ionising radiation facility for patients, visitors and staff, and aware of current patient and occupational exposure standards, guidelines and legislation for MR and US.

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### LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Perform risk assessment of non-ionising radiation facilities.
2. Provide recommendations and advise on safety relating to use of non-ionising radiation facilities.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe the day-to-day working of a non-ionising radiation imaging facility and critically review the facilities and working practice, discuss your observations with members of the multidisciplinary team, including issues around different field strength MR systems.
- Discuss a range of MR safe, MR conditional and MR unsafe devices/equipment, e.g. anaesthetic monitoring equipment, wheelchairs, MR conditional pacemakers, with members of the multidisciplinary team.
- Review patient safety checklists and observe a number of patients being screened (with their permission) against the checklist. Reflect on the impact of patient safety checklists on reducing error and improving patient safety.
- Perform a non-ionising radiation safety audit and discuss with your supervisor.
- Critically review the local health and safety rules and write a local safety policy for scanning volunteers that could be used as part of a research application to an ethics committee.
- Review the bioeffects present when using US and carry out a risk assessment of a particular application, e.g. 3D foetal scanning or contrast-enhanced scanning. Discuss your findings with your supervisor.
- Review the risks and contraindications of MR contrast agents.
- Participate in the electrical safety testing of a new non-ionising radiation imaging modality/facility.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1,2                   | Critically evaluate a non-ionising radiation facility design. | • Controlled areas, appreciation of external sources of interference on performance of non-ionising radiation, appreciation of clinical and technical requirements for siting.  
• Potential detrimental effect of non-ionising radiation on sensitive medical equipment. |
| 1,                    | Perform a comprehensive risk assessment of a non-ionising imaging facility or technique. | • Risk assessment techniques.  
• Health and safety legislation and codes of practice.  
• Bioeffects, consequences of exposure and control measures.  
• Issues associated with different commercially available systems: 1.5 vs. 3T, e.g. SAR, spatial gradient.  
• Safety evaluation of a device, e.g. deflection testing, MR conditional pacemakers. |
| 1                     | Identify and label equipment as MR safe, MR conditional or MR unsafe. | • Risks and hazards associated with equipment and implanted devices in the MR environment.  
• Control measures that can be implemented to minimise risk.  
| 1                     | Critically evaluate the safety for MR scanning of a range of inactive and active implants and foreign bodies. | • Risks and hazards (e.g. movement, heating, electrical stimulation) associated with a range of inactive and active implants and foreign bodies.  
• Where to seek information about the MR safety of implanted objects.  
• Risk assessment techniques in relation to implanted devices. |
<p>| 2                     | Provide recommendations on occupational exposure to non-ionising radiation based on measurements and published recommendations. | • Current guidelines, standards and legislation for occupational exposure. |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
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</thead>
</table>
| 2                    | Advise on limitation or reduction of patient exposure consistent with clinical requirements. | • Current guidelines, standards and legislation for patient exposure.  
• Methods to limit or reduce patient exposure. Knowledge of diagnostic or therapeutic impact of reducing exposure. |
| 2                    | Advise healthcare staff about non-ionising radiation safety.                 | • Physical principles underlying bioeffects, range and nature of exposures to cause bioeffects, clinical context and applicable limits. |
| 2                    | Interpret and apply current guidelines and standards in non-ionising radiation. | • Patient and occupational exposure standards (ICNIRP, IEC, EU Physical Agents Directive, MHRA guidelines, AGNIR, etc.).  
• Day-to-day local policy with regard to scanning patient presenting with common implants and devices (e.g. tattoos, piercings, jewellery, stents, clips and other passive devices). |
### MODULE 5
**Diagnostic Equipment Performance (INIR6)**  |  **COMPONENT** | **Specialist**

| AIM | To introduce the trainee to a range of equipment, techniques and performance measurements used in non-ionising radiation. |
| SCOPE | On completion of this module the trainee will understand the relationship between technical specification and imaging performance, the causes of poor imaging performance, and the methods/means to resolve the problems and know the range of commercially available non-ionising imaging equipment. |

### LEARNING OUTCOMES

**On successful completion of this module the trainee will:**

1. Perform, evaluate and report on acceptance testing and routine quality control of a non-ionising imaging system; where possible on a range of equipment.
2. Investigate and report on poor performance of non-ionising equipment.
3. Assess and evaluate equipment performance and compare with the manufacturer’s specifications.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe a range of quality control programmes where non-ionising radiation is used and critically review each programme, identifying good practice and making recommendations to your training supervisor for potential improvements.
- Identify and investigate examples of poor imaging performance and produce a written report identifying the cause(s) and recommending solutions to resolve the problem, and, where possible, providing practical evidence of the effect of your recommendations. Examples include images from a multi-coil array where one or more coil elements have failed. Images from an ultrasound probe with delamination or damaged crystals, or EMI or inappropriate frequency.
- Obtain information on a wide range of commercially available non-ionising imaging equipment and, where necessary, arrange visits to see equipment not available at the training centre and critically evaluate the clinical use of each system with respect to diagnostics and/or treatment.
- Gain an awareness of recent trends in ultrasound systems for example ‘point-of-care’ scanners with minimal choice of parameters or new clinical specialities with increasing ultrasound application (emergency department, respiratory), and reflect on the potential each device has to improve diagnostics.
- Investigate the development of a new hardware feature (e.g. development of 70 cm wide-bore or multichannel transmit systems) and present your findings at a departmental meeting.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1                     | Perform, and write a report based on the results from, acceptance testing of a non-ionising radiation imaging system. | • System operation.  
• Local/national/international quality standards relating to imaging equipment, e.g. IPEM, AAPM. Manufacturer proprietary testing methods.  
• Choice of appropriate test objects and imaging parameters. |
| 1                     | Write a protocol for routine quality control and advise on appropriate testing frequencies. | • Structure and guidelines for protocol writing.  
• Appropriate testing frequencies for quality control processes. |
| 3                     | Assess the relationship between underlying technical specifications and measured imaging performance. | • Relevant technologies and image formation process. |
| 2                     | Investigate, report and provide recommendations to rectify poor or faulty equipment performance. | • Relevant acquisition methodology and image formation.  
• Hardware and software limitations.  
• Clinical applications.  
• Relevant anatomy and physiology. |
| 3                     | Critically evaluate the range of commercially available non-ionising imaging equipment available. | • Technical and performance specifications.  
• Clinical applications. |
<table>
<thead>
<tr>
<th>MODULE 6</th>
<th>Emerging Technologies (INIR7)</th>
<th>COMPONENT</th>
<th>Specialist</th>
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<tbody>
<tr>
<td>AIM</td>
<td>To evaluate an emerging non-ionising radiation imaging technique.</td>
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<tr>
<td>SCOPE</td>
<td>On completion of this module the trainee will be able to critically evaluate, compare and contrast emerging technologies.</td>
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</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. MR/US: appraise the key issues of an emerging technique/technology.
3. MR/US: apply safety and clinical governance criteria to the evaluation of an emerging technique/technology.
4. MR/US: design a study to evaluate the impact of the emerging technique/technology on the clinical practice at the training centre.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Present the findings from a literature review of an emerging technique/technology at a departmental meeting.
- Observe the introduction of equipment or a new technique entering a healthcare environment and discuss the process of introduction with your training supervisor, comparing the process with guidelines.
- Discuss with other healthcare scientists how new techniques/technologies are developed and become clinically established.
- Explore the development and subsequent widespread clinical deployment of techniques such as propeller/blade/vane and critically appraise the impact of the development of patient care.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

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</table>
| 1,2,3 | Write a critical evaluation of the new imaging technique/technology with particular emphasis on its potential future role in patient care. | • Clinical context and the benefits for patient investigation, treatment and care.  
• Methods of health technology assessment and their application. |
| 4 | Design a study to evaluate the impact of the new technology/technique. Consider the ethical and Research and Development issues. | • Study design.  
• Ethical submission process.  
• Research and Development approvals process.  
• Risk assessment.  
• U/MHRA approval for investigational medical device. |
<table>
<thead>
<tr>
<th>MODULE 7</th>
<th>Information and Communication Technology (INIR8)</th>
<th>COMPONENT</th>
<th>Specialist</th>
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</thead>
<tbody>
<tr>
<td><strong>AIM</strong></td>
<td>Use information and communication (ICT) in a manner relevant to the modalities.</td>
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<tr>
<td><strong>SCOPE</strong></td>
<td>On completion of this module the trainee will have an understanding of MR and US data handling and analysis, including the principles of information governance and the underlying principles of ICT tools.</td>
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</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. MR/US: employ appropriate ICT skills in order to understand the structure of a DICOM image and consequently anonymisation of data sets for data transfer.
2. MR/US: employ appropriate ICT skills to develop an in-house software-based project; this could include pulse sequence development (if trained) or an image analysis task.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe the transfer, archiving and display of medical images within radiology and other relevant areas within secondary care, and critically analyse the process identifying strengths and potential for improvement against local guidelines.
- Follow the ICT workflow from patient referral and appointment, through modality work list, data acquisition, archiving and reporting, and discuss with your supervisor the impact of ICT workflow on the throughput of the department and the patient.
- Observe the working of a diagnostic imaging service and critically appraise the ICT infrastructure requirements for the service.
- Develop a software application to support either image acquisition or analysis.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1                     | Critically review information governance policies in the trust with particular emphasis on those relevant to Radiology. | • Information governance principles and practice.  
                           • Information commissioner.  
                           • Caldicott principles.  
                           • Information assets and the role of the information asset owner, information asset administrator and the senior information risk officer. |
| 2                     | Use or write software to manipulate Digital Imaging and Communications in Medicine (DICOM) headers. Anonymise DICOM images and use different software to verify the anonymisation. | • DICOM standard. |
| 1,2                   | Describe the data flows involved between a patient being allocated an appointment and the images finally being reported by a radiologist. | • Principles of hospital information systems, radiology information systems, picture archiving and communications systems, brokers, DICOM transfers. |
| 2                     | Develop a software application to support either image acquisition or analysis. The software should be appropriately documented, commented, tested and, where possible, deployed. | • Underlying physics of the task.  
                           • Appropriate software tools.  
                           • Appropriate use of software coding standards.  
                           • EU Medical Device Directive. |
SECTION 7: SPECIALIST LEARNING FRAMEWORK IMAGING WITH IONISING RADIATION
This section describes the Learning Framework for the **Specialist Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

### Specialist Modules

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<td>THEME</td>
<td>Medical Physics</td>
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<tr>
<td>SPECIALISM</td>
<td>Imaging with Ionising Radiation</td>
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## IMAGING WITH IONISING RADIATION – SPECIALIST MODULES

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<td>Radiopharmacy</td>
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<td>Module 5 (IIR5)</td>
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<td>Module 6 (IIR6)</td>
<td>Diagnostic Radiology: Equipment Performance</td>
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<td>Module 7 (IIR7)</td>
<td>Diagnostic Radiology: Image Optimisation and Patient Dose Measurement</td>
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<td>Module 8 (IIR8)</td>
<td>Information and Communication Technology</td>
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## MODULE 1

<table>
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<th>Radionuclide Imaging (IIIR1)</th>
<th>COMPONENT</th>
<th>Specialist</th>
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<tbody>
<tr>
<td><strong>AIM</strong></td>
<td>The trainee can participate in the full range of equipment and clinical functions expected in radionuclide imaging.</td>
<td></td>
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<tr>
<td><strong>SCOPE</strong></td>
<td>On completion of this module the trainee will be able to test and calibrate a range of radionuclide imaging equipment and provide advice and support for the clinical imaging service.</td>
<td></td>
</tr>
</tbody>
</table>

### LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Perform and interpret measurements on imaging equipment, including gamma cameras, Single-photon emission computed tomography (SPECT/CT) scanners and Positron emission tomography (PET)/Computed Tomography (CT) scanners, advising on the acceptability of their clinical use in a range of contexts.
2. Advise on the acquisition and processing of clinical planar, SPECT and PET images.
3. Analyse images to extract quantitative information and increase diagnostic utility.
4. Contribute to the clinical interpretation and reporting of images.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

• Produce a case study for a patient undergoing a nuclear medicine imaging procedure and participate in the multidisciplinary reporting of clinical images for that case study.
• Produce information for patients, including estimation of risk.
• Produce a plan and timetable for acceptance testing of a major piece of imaging equipment, to include evaluation of the equipment in terms of its effectiveness in service delivery and improvement in patient care.
• Produce a report summarising performance testing, calibration and recommended actions for at least one major piece of imaging equipment.
• Perform a literature search on a new or novel imaging procedure and provide a critical report, to include key aspects of innovation and improvement for service delivery and patient care.
• Prepare a standard operating procedure for a new or novel imaging technique, to include, where appropriate, patient handling.
• Perform a radiation risk assessment for a new or novel imaging technique with regard to patients, staff and members of the public.
• Produce or modify image analysis software for a clinical or non-clinical application and include rationale for improvement in patient care.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1                     | Perform planar gamma camera commissioning tests and participate in the commissioning tests of Single-photon emission computed tomography (SPECT)/ Computed Tomography (CT) and Positron emission tomography (PET)/(CT) scanners. | • Correct and safe operation of imaging equipment.  
• Factors that affect dose and image quality in the context of intended use.  
• The benefits to patient treatment and care of performing commissioning tests.  
• Individual types and components of instrumentation.  
• Standards applicable to radionuclide imaging equipment, including National Electrical Manufacturers Association (NEMA), national standards and manufacturer’s guidance.  
• Current guidelines and legislative requirements for imaging equipment testing.  
• Analysis of performance trends.  
• Performance criteria, including remedial and suspension levels, for a broad range of imaging equipment.  
• Likely causes of degradation of image quality and timescale over which common defect types progress.  
• Awareness of escalation pathway for corrective action (e.g. first-line action, when to contact manufacturer).  
• Principles of quality assurance and equipment quality control, including the key performance parameters for testing.  
• The range of suitable tests to carry out on equipment to establish safe, consistent and expected operation.  
• Errors and statistical analyses.  
• The performance and limitations of test procedures.  
• Appropriate specifications for different clinical requirements.  
• Appropriate level of accuracy and precision for a range of tests.  |
<p>| 1                     | Make comprehensive quantitative routine performance measurements on imaging equipment. | |
| 1                     | Critically review quality assurance programmes for radionuclide imaging. | |
| 1                     | Instigate corrective action based on an evaluation of quality control results. | |
| 1,4                   | Understand the wider clinical | • The wider clinical indications for a broad range of standard |</p>
<table>
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</table>
|                      | situation relevant to patients presenting to the modality. | radionuclide imaging procedures.  
• The patient experience, expectations and needs associated with the modality, including patient information. Alternative/complementary modalities. |
| 2,3,4 | Develop and evaluate protocols for the optimal acquisition, processing and display of clinical images. | • Consequences of the selection of acquisition parameters (e.g. matrix size, collimator, dynamic phasing, etc.).  
• The techniques and applications inherent in standard image processing and types of errors that may result. |
| 2 | Write standard operating procedures for radionuclide imaging. | • The range of radiopharmaceuticals, radioactivity administered and radiation dose in relation to clinical studies, including patient preparation and imaging parameters. |
| 3 | Use sophisticated image analysis software to extract quantitative information and enhance diagnostic utility. | • Full range of methods to accurately extract quantitative data, e.g. ROI analysis and various background subtraction methods.  
• Attenuation correction.  
• Scatter correction. |
| 3 | Modify and develop image acquisition and analysis software. | • Specific application software or programming language. |
| 3 | Explain the cause and effect of a range of artefacts and of equipment performance limitations on the interpretation of clinical images. | • Performance characteristics on a range of imaging equipment.  
• Normal appearances of a range of diagnostic images. |
| 2 | Participate in the clinical audit of radionuclide imaging in nuclear medicine. | • Ethical and governance regulations and guidance.  
• Risks associated with the procedure. |
AIM
The trainee can undertake and process non-imaging radionuclide tests and ensure equipment is calibrated and fit for purpose.

SCOPE
On completion of this module the trainee will be able to correctly and safely operate a range of equipment used in non-imaging studies. This should include quality assurance and set-up, processing and interpretation of results. The trainee will be able to use a wide range of equipment and understand the application and limitations of each. The trainee will also participate in a range of non-imaging in-vivo and in-vitro tests.

LEARNING OUTCOMES
On successful completion of this module the trainee will:

1. Perform and interpret measurements on equipment for non-imaging diagnostic tests, for example uncollimated gamma cameras, intra-operative gamma probes, uptake counters, gamma spectrometers, manual and automatic beta and gamma sample counters, and whole body counters. This should include associated equipment such as balances, centrifuges and pipettes.
2. Ensure that all equipment used is calibrated and fit for purpose.
3. Advise on the acquisition and processing of data, including set-up and calibration of equipment.
4. Contribute to the analysis and clinical interpretation and reporting of results.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Carry out an audit of a non-imaging procedure to establish compliance with available guidance.
- Modify and develop data analysis software (as far as local arrangements allow), with independent verification of results, evaluate the development in terms of possible improvements in service delivery and patient investigation and treatment.
- Review a number of patient results and critically appraise the pathway for referral, diagnosis and treatment from a multidisciplinary team.
- Identify a patient referred for a non-imaging investigation. Review clinical details and with the help of medical colleagues assess the results and the implications.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</thead>
</table>
| 1                     | Make comprehensive quantitative performance measurements on non-imaging equipment. | • Equipment and its relationship to clinical purpose.  
                         |                                         | • The range of clinical conditions associated with the procedures carried out on the equipment. |
| 1                     | Plan and perform commissioning tests on beta and gamma counters and gamma spectrometers. | • Capability and specification of equipment and an understanding of it in relationship to clinical purpose. |
| 1,2                   | Critically review quality assurance programmes for the equipment used for non-imaging diagnostic tests. | • Relevant national legislation and associated guidance.  
                         |                                         | • Restrictions defined in local rules and other documentation.  
                         |                                         | • Existing quality system and an understanding of its relationship to legislation and any limitations of use. |
| 1,3                   | Instigate appropriate corrective action based on an evaluation of test results. | • Definition of key performance levels.  
                         |                                         | • Evidence for action levels and written procedures for the handling of problems.  
                         |                                         | • Local duty holders and their roles and responsibilities. |
| 3                     | Choose appropriate tissue – equivalent phantoms for quantitative in-vivo uptake measurements. | • Existing phantom material available and any limitations.  
                         |                                         | • Tests for suitability. |
| 2                     | Develop and critically evaluate the optimal acquisition and processing of data. | • Operation of a range of equipment.  
                         |                                         | • Impact on patient experience. |
| 2                     | Write standard operating procedures (SOPs) for non-imaging tests. | • Relevant guidance and legislation.  
                         |                                         | • The impact of SOPs on patient experience of non-imaging investigations.  
                         |                                         | • Implications for staff (control of substances hazardous to health (COSHH) considerations, radiation doses received, etc.). |
| 1,4                   | Participate in a range of non-imaging in-vivo and in-vitro tests. | • Theoretical clinical investigations for in-vivo and in-vitro tests.  
                         |                                         | • Stated local levels of supervision.  
<pre><code>                     |                                         | • Patient needs in relation to non-imaging tests. |
</code></pre>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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</tr>
</thead>
</table>
| 4                     | Generate results and assist in the interpretation of diagnostic tests, including the use of reference ranges. | • Standard procedures interpretation of results based on clinical details.  
• Methods of reporting results. |
| 4                     | Explain the cause and effect of a range of artefacts, and of equipment performance limitations and patient-related factors on the interpretation of results. | • How significant these factors are to clinical results, how they are caused and how to minimise them. |
| 3                     | Advise on the clinical appropriateness of non-imaging diagnostic tests. | • Standard referral criteria.  
• Any necessary patient preparation or continued behaviours during test period (e.g. dietary restrictions during test, drug preparation required, length of time since other specific investigations) that would otherwise affect the result. |
| 2                     | Perform clinical audit of non-imaging diagnostic nuclear medicine. | • IRMER and other legislation and guidance.  
• Equipment replacement programmes and budgetary considerations. |
# MODULE 3  
**Radionuclide Therapy (IIR3)**

<table>
<thead>
<tr>
<th>AIM</th>
<th>The trainee can plan and perform radionuclide therapies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOPE</td>
<td>On completion of this module the trainee will be able to work as part of a multidisciplinary team in the planning and performing of a range of outpatient and inpatient radionuclide therapies, contributing specialist advice as appropriate.</td>
</tr>
</tbody>
</table>

## LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Advise on the choice of radiopharmaceutical for radionuclide therapy in terms of the physical properties of the radionuclide, the physiological properties of the radiopharmaceutical and the clinical context of the procedure.
2. Advise on and perform practical aspects of the administration of radionuclide therapy to patients.
3. Specify, and explain to the patient, the post-therapy behavioural restrictions placed on them.
4. Specify the facilities required for radionuclide therapy.
5. Implement and advise on the principles of management of radiation safety associated with radionuclide therapy administrations and patients.
6. Undertake practical radiation safety tasks required to deliver a service, including the effective communication of risk, decontamination procedures and radioactive waste management.
7. Specify and perform the radiation monitoring of inpatients to determine their point of release.
8. Implement the principles of internal radiation dosimetry, patient-specific dosimetry protocols and their requirements for data acquisition and analysis.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Identify **at least two** patients undertaking radionuclide therapy and tailor behavioural restrictions based on their individual circumstances. Discuss and review with your supervisor.
- Prepare or modify patient information for a specific procedure and discuss this with your supervisor.
- Advise new ward staff on radiation safety for a particular type of therapy.
- Follow a patient through therapy administration and subsequent monitoring and provide a report prior to discharge. Review and evaluate the monitoring process, including the effect on patient engagement, experience and outcome.
- Participate in the acquisition of data collected to determine tracer retention for patient-specific dosimetry. Discuss your results with your supervisor.
- Prepare an audit to compare local practice with current guidance and recommend any changes required.
- Perform a case study of a particular patient based on their clinical indications, imaging, therapy and post-treatment outcome.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 2,3,4,7              | Generate or critically review the design of suitable equipment and facilities for patient therapies- | • Design of inpatient rooms for radiation protection, including fixed and/or portable room shielding, aqueous waste management and minimisation of contamination.  
• Shielding, e.g. for internal transport, administration, waste containment.  
• The patient experience and needs of patients including those with physical or language difficulties. |
| 1,2                  | Advise on the appropriateness of requests for the administration of radionuclide therapy. | • Clinical applications of radionuclide therapy.  
• Relevant requirements under IRMER, IRR99, MDGN, revision of local rules. |
| 1,2,3                | Prepare or critically review a radiation risk assessment for the administration of a particular form of radionuclide therapy. | • Requirements of radiopharmaceutical regarding route of administration and radiation protection.  
• Risks for patients, staff and the public.  
• Information needs of patients associated with radionuclide therapy. |
| 2,3,5                | Write or critically review standard operating procedures for the administration of particular form(s) of radionuclide therapy, incorporating the results of the risk assessment. | • Radiopharmaceutical retention and route(s) of excretion, IRR99.  
• Effective written and oral communication with regard to radiation protection. |
| 2,3                  | Perform a tailored radiation risk assessment and instructions for those in contact with an individual radionuclide therapy outpatient. | • Requirements of local rules to address the delivery of this service.  
• Systems of work for good and safe practice.  
• Contingency planning staff needs for information and advice.  
• Support available for staff who support inpatients. |
<p>| 2,3,4,5,7            | Prepare or review written instructions for staff on the management of inpatients receiving a particular radionuclide therapy, and give advice to staff in |</p>
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<td>according.</td>
<td>• Inpatient needs in relation to information, advice and support.</td>
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</table>
| 2,6                   | Actively contribute to the administration of a range of radionuclide therapies, including at least iodine-131 for thyroid cancer and benign thyroid disease. | • Appropriate radiation protection advice, including monitoring programmes, design and testing of customised radiation shielding, and radioactive waste management under EPR.  
• Training of non-specialist clinical staff in radiation protection as applied to their role.  
• The patient experience of administration of oral radiopharmaceuticals and their need for information and support. |
| 2,6                   | Assist and advise medical practitioners in the administration of non-oral radionuclide therapies, e.g. by intravenous infusion. | • Appropriate radiation protection advice, including monitoring programmes, design and testing of customised radiation shielding, and radioactive waste management under EPR.  
• Training of non-specialist clinical staff in radiation protection as applied to their role. |
| 3                     | Advise patients and their carers on appropriate post-therapy behavioural restrictions. | • Requirements for behavioural restriction in outpatient and inpatient contexts, and with reference to the specific radionuclide and radiopharmaceutical, and relevant individual patient circumstances. |
| 7                     | Actively participate in the monitoring of inpatients to determine effective half-life and/or residual activity and managing the criteria for release of inpatients based on the results of this monitoring. | • Physical properties of radionuclide(s) used, and retention and route(s) of excretion of radiopharmaceuticals used.  
• The appropriate selection, operation, calibration and quality assurance of radiation monitors/detectors.  
• Relevant requirements under IRMER, IRR99, MDGN.  
• Patient engagement in the monitoring process. |
| 6                     | Perform contamination monitoring and decontamination of a treatment room post radionuclide therapy administration. | • Radiopharmaceutical retention and route(s) of excretion.  
• Ionising Radiations regulations 1999 (IRR99), Environmental Permitting Regulations (EPR).  
• Selection and operation of contamination monitors, including detectors, decontamination measures and radioactive waste management under EPR. |
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<tbody>
<tr>
<td></td>
<td></td>
<td>• Implications of ineffective monitoring and decontamination for patients, staff and public.</td>
</tr>
<tr>
<td>6</td>
<td>Record, store and dispose of radioactive waste produced as a result of radionuclide therapy.</td>
<td>• EPR requirements for management of radiation waste and detailed compliance with EPR conditions.</td>
</tr>
<tr>
<td>1-8</td>
<td>Participate in clinical audit of radionuclide therapy.</td>
<td>• Awareness of appropriate metrics to audit and awareness of the audit process, including audit loop.</td>
</tr>
<tr>
<td>7,8</td>
<td>Actively participate in acquisition of imaging data and/or data from radiation detectors/monitors.</td>
<td>• Data acquisition protocols optimised for the acquisition of quantitative data collected to determine organ, tumour and/or whole body retention for patient-specific dosimetry protocols.</td>
</tr>
</tbody>
</table>
| 8                    | Actively participate in calculating absorbed radiation doses to target and non-target tissues for therapy protocols guided by patient-specific dosimetry. | • The principles of internal radiation dosimetry for determining patient specific organ/whole body and tumour radiation doses.  
• The importance of tumour (target) dose and critical normal organ/whole body doses in the planning and management of patient-specific radionuclide therapies.  
• Protocols for the patient-specific determination of tumour and/or normal organ/whole body radiation dose. |
AIM
The trainee has a detailed understanding of requirements for the safe production of radiopharmaceuticals, including quality systems, and can advise on radiation safety requirements and regulatory compliance for the radiopharmacy.

SCOPE
On completion of this module the trainee will understand the principles of good manufacturing practice and quality systems for radiopharmaceutical production.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Obtain a detailed knowledge of the quality system used in radiopharmaceutical production, including production facilities and radiopharmaceutical quality control.
2. Advise on best practice in the use of a radionuclide calibrator.
3. Apply radiation safety practice and regulatory compliance in the context of a radiopharmacy.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

• Observe and review a monitoring programme (e.g. environmental, microbiological, product quality control) and reflect/report on its importance both for service delivery and for patient safety.
• Critically review one or several aspects of the quality system in terms of its effect on service delivery and patient safety.
• Perform an audit of regulatory compliance against legislation concerning the use of radioactivity.
• Conduct a training exercise for simulated radioactive liquid spills, monitor the exercise and report on its effectiveness, the implications of inappropriate or untimely response and the knock-on effect on patients, staff and public (optional).
• Conduct a radiation dose review for staff in the radiopharmacy, and report and present to colleagues with your proposals for improvement (optional).
• Discuss the role of the quality system in assuring the quality of radiopharmaceuticals (optional).

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

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</thead>
</table>
| 1,3                   | Advise colleagues on the use of radiopharmaceuticals. | • Information needs of colleagues.  
• Risks associated with the handling, storage, preparation and use of radiopharmaceuticals.  
• Protocols and procedures for preparation and issue of radiopharmaceuticals. |
| 1,3                   | Access sources of information on the design requirements for the production of radiopharmaceuticals. | • Requirements for facilities, equipment, training and environment.  
• Good Manufacturing Practice requirements.  
• MHRA recommendations.  
• National and international guidance. |
| 3                     | Critically review environmental and personal monitoring including which tests are performed and frequency of testing. | • Sources of contamination.  
• Viable contamination monitoring.  
• Particle counting methods and limits.  
• Process validation. |
| 1,3                   | Comply with relevant quality assurance requirements associated with radiopharmaceuticals. | • Describe requirements for quality systems, including specification, document control, validation, monitoring, change control, error analysis, risk assessment and corrective and preventative action (CAPA).  
• The risks for patients, staff and public associated with non-compliance. |
| 2                     | Perform commissioning tests on radionuclide calibrators. | • Range of tests performed – linearity, accuracy and precision.  
• Range of radionuclides used and relative response of calibrator. |
| 2                     | Perform periodic quality control tests on radionuclide calibrators and recommend procedures for optimisation of measurements. | • Range and frequency of tests performed, including the accuracy of radionuclide calibrators against a secondary standard instrument for a range of radionuclides (including Technetium-99m, Iodine-131 and Fluorine-18).  
• Derivation of calibration factors for geometric corrections.  
• Use of filters (e.g. copper filters for I-123). |
<p>| 2                     | Use radionuclide calibrators for the | • Measurement errors for beta-emitting radionuclides. |</p>
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<td></td>
<td>measurement of therapeutic activities of radionuclides.</td>
<td>• Use of calibrators for other therapeutic agents.</td>
</tr>
<tr>
<td>3</td>
<td>Review compliance of radiopharmacy procedures against relevant radiation</td>
<td>• Legislation covering radiation safety of the staff, public and patients; transport of</td>
</tr>
<tr>
<td></td>
<td>regulations and guidance.</td>
<td>radioactive materials and radioactive waste management as it applies to a radiopharmacy.</td>
</tr>
</tbody>
</table>
AIM  
The trainee can, under supervision from a radiation protection adviser, advise on the radiation safety requirements for nuclear medicine and diagnostic radiology facilities.

SCOPE  
On completion of this module the trainee will be able to perform radiation risk assessment, including calculation of estimated absorbed, equivalent and effective doses. They will be proficient in the design of facilities and will be able to respond to radiation incidents within published guidelines.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Understand the hierarchy of control measures available to ensure safe practice in a diagnostic imaging room and in the safe handling of sealed and unsealed radioactive sources.
2. Calculate estimated absorbed, equivalent and effective doses to patients, and effective doses to staff and members of the public for diagnostic X-ray and radionuclide procedures.
3. Specify the theoretical and practical requirement involved in room design for diagnostic imaging facilities.
4. Compare and contrast the radiation safety requirements for diagnostic X-ray imaging, nuclear medicine imaging and radionuclide therapy.
5. Advise patients, colleagues and other professionals on radiation safety issues.
6. Deal with radiation incidents.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Take part in a local radiation protection committee meeting and reflect on the way the multidisciplinary team contributes to the safety of patients, staff and the public in areas in which radiation is used.
- Attend a meeting at which the outcome of a clinical audit, research, innovation or service development is presented and discuss with your training supervisor how evidence-based practice is implemented with respect to radiation safety.
- Observe a series of patients receiving treatment or investigations involving radiation, with permission, and critically appraise the process and the implications for effective radiation safety.
- Plan a simulated radiation incident and the responses/action required across a multidisciplinary team. Review and discuss with your supervisor, including the implications of incident for patients, staff and the public, internal and external standards, guidance and procedures, possible improvements in current practice and the impact on your own future practice.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

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</table>
| 1,4                   | Undertake risk assessment for a range of radiation facilities and a range of radiation hazards, to include external and internal, low energy and high energy, X-ray, gamma, beta and positron. | • Methods of risk assessment.  
• Sources, extent and significance of hazards to:  
  • patients and their carers  
  • staff  
  • public  
  • the organisation. |
| 1,3                   | Write local rules for a diagnostic imaging area, including contingency planning. | • Application of relevant legislative requirements, e.g. IRR99 with reference to good practice guides (e.g. MDGN).  
• Requirements of other legislation, IRMER, MARS, EPR2010, RSA93 (Scotland).  
• Local hospital policies. Reporting policy to relevant external agency, e.g. Environment Agency (EA), Care Quality Commission (CQC), Health and Safety Executive (HSE). |
| 1,3                   | Write local rules for nuclear medicine facilities and services, including contingency planning. |  

| 6                     | Critically appraise IRMER procedures for a radiation facility.              |  

| 3,5                   | Review the results of whole body and extremity radiation dose monitoring of staff and take remedial action as appropriate. | • Dose limits and appropriate constraints. |
| 5                     | Give advice to diagnostic and therapy patients on the precautions that they should follow on their return home, with particular regard to the safety of children, unborn foetuses and breast-fed infants. | • Issues relevant to clearance of tracer, dose limits, Administration of Radioactive Substances Advisory Committee (ARSAC) notes for guidance on breast-feeding.  
• Professional bodies. |
<p>| 5                     | Give radiation safety advice to a range of healthcare staff in connection with nuclear medicine patients. | • Basic knowledge of dose rates from nuclear medicine patients and how they vary with time for a range of radionuclides |
| 6                     | Deal with a spillage of liquid                                             | • Local rules and other sources of information, e.g. MDGN. Also IRR |</p>
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<td>radioactive material and perform subsequent decontamination measures.</td>
<td>and EPR.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Calibrate contamination monitors for measuring the surface activity of a range of radionuclides, including technetium-99m, iodine-131 and a pure beta emitter.</td>
<td>• Function and operation of contamination monitors and their suitability for detecting different types of radiation, e.g. beta and gamma.</td>
</tr>
<tr>
<td>1</td>
<td>Manage a quality assurance programme for radiation monitors.</td>
<td>• National guidance and legislation.</td>
</tr>
<tr>
<td>1,3</td>
<td>Participate in the management of the storage, disposal and record keeping of radioactive waste.</td>
<td>• Management requirements of an EPR permit. • Role of the radioactive waste manager.</td>
</tr>
<tr>
<td>1</td>
<td>Perform radiation protection audits for nuclear medicine.</td>
<td>• Requirements of EPR, IRR99 and other legislation as set out in MGDN.</td>
</tr>
<tr>
<td>1</td>
<td>Critically review policies and procedures for regulatory compliance.</td>
<td>• Relevant legislation. • Role of duty holders, e.g. Radiation Protection Supervisor (RPS), Radiation Protection Advisor (RPA), Medical Physics Expert (MPE).</td>
</tr>
<tr>
<td>2</td>
<td>Collect data for the calculation of estimated absorbed, equivalent and effective doses to patients, and effective doses to staff and the public.</td>
<td>• Method of calculation (MIRD).</td>
</tr>
<tr>
<td>2</td>
<td>Calculate estimated radiation dose and radiation risk where relevant in relation to a particular incident.</td>
<td>• Theoretical knowledge of dosimetry.</td>
</tr>
<tr>
<td>MODULE 6</td>
<td>Diagnostic Radiology: Equipment Performance (IIR6)</td>
<td>COMPONENT</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------------</td>
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</tr>
<tr>
<td>AIM</td>
<td>To enable the trainee to manage the testing and performance of a wide range of diagnostic radiology facilities</td>
<td></td>
</tr>
<tr>
<td>SCOPE</td>
<td>On completion of this module the trainee will be able to test a range of diagnostic imaging equipment, interpreting results and providing advice. The trainee will understand the requirements of accuracy and precision of a procedure in the context of diagnostic procedures and use this information appropriately, with an understanding of the consequences arising from the trainee advice.</td>
<td></td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Measure and record levels and characteristics of radiation.
2. Calibrate and test equipment that measures radiation.
3. Perform measurements appropriate to safety testing, commissioning and periodic routine testing of a wide range of diagnostic systems.
4. Devise an appropriate test schedule for safety testing, commissioning and routine testing for a diagnostic imaging system new to the trainee.
5. Devise and undertake the specification and evaluation of new diagnostic systems.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- In addition to working within the host department, the trainee should visit another diagnostic radiology physics department and compare test equipment, protocols and frequencies. This will enable the trainee to reflect on the procedures and test equipment in the host department, looking at best/poor practice in quality assurance.
- The trainee should compare and contrast available test equipment with regard to specifications and ease of use. This may also include a review of available calibration facilities and the procedures performed on calibration.
- The trainee should attend some multidisciplinary sessions with regard to expanding their clinical knowledge about the uses of ionising imaging.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 2                     | Decide on appropriate tests to apply to the assessment of the measuring device to ensure that it is performing according to its specified standard. | ● Monitor specifications, the range of radiations they cover and performance.  
● Radiation characteristics.  
● The correct application of national guidance on testing of radiation monitors.  
● Requirements for traceability of standards.  
● Appropriate contractors to use.  
● Local procedures and work instructions.  
● Safe handling of sealed/unsealed radioactive sources.  
● Calibration factors.  
● Applicability of the results.  
● Range of dose rates and energies appropriate to clinical use. |
| 1                     | Undertake and/or arrange for tests to be carried out in an environment, and with facilities, that are appropriate and traceable to national standards. | |
| 2                     | Obtain and interpret the results of tests and calibrations and report on the performance on the equipment. | |
| 3,5                   | Perform commissioning and acceptance tests on simple X-ray equipment and detectors. | ● Safe operation of equipment.  
● The implications of unsafe performance for staff and patients.  
● Commissioning specific tests.  
● Engineering safety features.  
● Appropriate warning signs and signals. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                    | Safely operate and perform routine quality assurance measurements on mammography equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Awareness of the differences in design between mammography and general equipment in the context of choosing the correct test equipment and appropriate test protocols.  
• Different types of detector systems.  
• Current national quality assurance guidance. |
| 3,5                  | Perform commissioning and acceptance tests on mammography equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals. |
| 3                    | Safely operate fluoroscopy systems and perform appropriate routine quality assurance measurements | • Awareness of different designs, C-Arm, under or over-table tubes, bi-plane rooms, mobile units.  
• Current national quality assurance guidance. |
| 3,5                  | Perform commissioning and acceptance tests on fluoroscopy equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals.  
• Scatter measurements. |
| 3                    | Safely operate CT systems and perform appropriate routine quality assurance measurements. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Practical use of dosimetric quantities such as CTDIc and CTDIw.  
• Basic theoretical knowledge of the image production.  
• Effect of kV and reconstruction kernel on the images obtained for quality assurance.  
• Current national quality assurance guidance. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 3,5                    | Perform commissioning and acceptance tests on CT X-ray equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals.  
• Scatter measurements. |
| 4                      | Devise test schedule for a diagnostic imaging system new to the trainee. | • National guidance and its correct application.  
• Clinical use of equipment.  
• Appropriate choice of clinical user tests and test equipment.  
• Risk management – cost/benefit. |
| 4                      | Instigate corrective action based on an evaluation of safety performance results. | • Likelihood and prevalence of risks and the impact on patient safety, experience and care. |
| 4                      | Critically review safety performance programmes and make recommendations if appropriate. | • Equipment parameters that may affect safe use, and mechanisms of testing. Interlocks and engineering controls used to restrict exposure. |
| 5                      | Devise and undertake a critical examination for complex equipment, for example a cardiac intervention suite or CT scanner. | • The risks associated with the clinical operation of the equipment, the importance and function of relevant interlocks and safety features, and the implications for staff and patients. |
MODULE 7  
Diagnostic Radiology: Image Optimisation and Patient Dose Measurement (IIR7)  
COMPONENT Specialist

AIM  
To enable the trainee to undertake the assessment of patient dose and image quality in order to implement interventions for the optimisation of a range of imaging systems.

SCOPE  
On completion of this module the trainee will be able to assess the patient doses and image quality.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Perform measurements to assess image quality in various types of equipment, to include computer radiography, digital radiography, CT and image intensifier systems.
2. Perform appropriate measurements and/or calculations to assess patient dose for a range of examinations, which must include examples from radiographic, fluoroscopic, CT and mammographic examinations.
3. Analyse patient dose measurements and, in the context of optimisation, draw conclusions.
4. Assess, by simulation and/or measurement, patient dose reduction interventions.
5. Calculate organ dose and effective dose, relate dose to risk and effectively communicate the risk.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Identify a patient who has been referred for diagnostic imaging investigation and, with permission, devise an investigation strategy for the optimisation of image quality against patient doses taking account of the clinical need. Reflect, review and discuss in terms of the effectiveness of the strategy and patient needs, experience and care, and demonstrate knowledge and understanding relating to competences associated with calculating patient dose reduction.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Review and critically appraise the patient dose measurement framework.</td>
<td>• Internal policies and procedures and national guidance.</td>
</tr>
<tr>
<td>1</td>
<td>Review and analyse methods for assessment of image quality in a range of diagnostics radiology equipment, including computed radiography, digital radiography, CT and image intensifier systems.</td>
<td>• Standards for image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods for measurement of image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How images are formed, processed and displayed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Data processing of images.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Test equipment for assessment of image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Parameters to describe image quality.</td>
</tr>
<tr>
<td>1</td>
<td>Undertake measurements to assess image quality in a range of diagnostics radiology equipment, including computed radiography, digital radiography, CT and image intensifier systems, and interpret results in the context of the clinical use.</td>
<td>• Factors affecting image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Artefacts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Image quality requirements under different clinical situations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Implications for patient treatment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Performance for different types of image detectors and appropriateness for various types of imaging.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Test equipment to match task.</td>
</tr>
<tr>
<td>2</td>
<td>Undertake measurements to assess the patient dose in the equipment settings used to assess image quality above and advise on appropriate diagnostic reference levels.</td>
<td>• Operation of patient dose indicators on equipment and their limitations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Units used to describe patient dose.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Translation of measured values into dose quantities and effective dose.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods of calibration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Risks to the patient.</td>
</tr>
<tr>
<td>1</td>
<td>Review and develop parameters for assessing clinical image quality with clinical staff.</td>
<td>• Parameters used to measure and describe image quality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clinical requirements and how the various factors can affect clinical image quality.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
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<td>-----------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3,4</td>
<td>Review the outcome of image quality and patient dose measurements in a range of systems and recommend optimisation strategies. Assess by simulation or measurement the effect of the optimisation suggested.</td>
<td>• National DRL/local DRL procedures and correct application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Image quality/patient dose trade-off.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Effect of exposure parameters on image quality and patient dose.</td>
</tr>
<tr>
<td>5</td>
<td>Calculate organ dose and effective dose for a range of investigations.</td>
<td>• Relevant software and how the input factors affect organ dose and effective dose.</td>
</tr>
<tr>
<td>5</td>
<td>Calculate radiation risks and communicate them effectively to various staff groups and the patient.</td>
<td>• Everyday risks in the context of radiation risks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Benefits and detriments of radiation.</td>
</tr>
<tr>
<td>MODULE 8</td>
<td>Information and Communication Technology (IIR8)</td>
<td>COMPONENT</td>
</tr>
<tr>
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</tr>
<tr>
<td>AIM</td>
<td>To enable the trainee to support the information and communication technology (ICT) infrastructure in diagnostic imaging departments.</td>
<td></td>
</tr>
<tr>
<td>SCOPE</td>
<td>On completion of this module, the trainee should be able to describe the ICT structure in the imaging department and develop or modify image processing software for clinical use.</td>
<td></td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Comply with the information governance and operational management requirements for clinical systems.
2. Identify the ICT infrastructure requirements for a diagnostic imaging service, including networking, data storage and interconnectivity.
3. Develop, validate and verify novel image processing applications in diagnostic imaging.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Identify a clinical application for which a new software solution would improve both service delivery and patient outcome experience, develop specification and prototype, and discuss and review with your supervisor.
- Based on your experience, critically appraise the existing imaging system ICT structure and make evidence-based recommendations for improvements.
- Validate a new piece of software following a system upgrade.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Critically appraise the information governance and operational management requirements for departmental systems. | • Outline the NHS strategy for use of ICT in healthcare.  
• Detailed awareness of data protection principles and associated legislation.  
• Relevant ICT standards adopted by the NHS.  
• Methods of protecting security of Picture Archiving and Communications System (PACS), patient information systems and system security clearances. |
| 1                     | Write procedures for the operational management of a clinical computer system. | • Operational procedures in the various imaging modalities and key imaging requirements.  
• Operations of major components of computers, including hardware, software, computer topologies and networks.  
• Implications of upgrades (hardware and software). |
| ?                     | Undertake a range of system administration tasks on a nuclear medicine or diagnostic radiology system. | • Methods of testing of hardware and software to ensure operations are within system performance standards.  
• Methods of protecting integrity of a system, including back-up and disaster recovery procedures, anti-virus software, firewalls, authentication and encryption. |
| 2                     | Critically appraise the ICT infrastructure requirements for a diagnostic imaging service. | • Diagnostic imaging requirements of the various modalities.  
• Requirements and limitations for networking systems. |
| ?                     | Discuss the interconnectivity requirements of DICOM. | • Relevant DICOM statement.  
• Local and wide area networking with reference to the ISO model and network topologies. |
| 3                     | Write a user specification for the requirements of a novel image processing application. | • How to analyse a problem and identify the parts that are appropriate for a computer-based imaging solution.  
• End-user requirements.  
• Competencies of the user in regard to using the system.  
• Appropriate image processing software tools. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
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</tr>
</thead>
</table>
| 3                     | Develop a novel image processing application. | • Document each routine and clear description of each image manipulation.  
|                       |             | • Select, justify and apply appropriate techniques and principles to develop data structures and algorithms for the solution of problems.  
|                       |             | • Design, implement and document an effective solution using appropriate software. |
| 3                     | Develop and implement a verification and validation plan for a novel image processing application. Release application software for clinical use. Audit use in clinical environment. | • Appropriate software testing standards.  
|                       |             | • Use test data to verify and validate data, including simulated and real clinical image data.  
|                       |             | • Documentation of test results is required. |
| 3                     | Write user and technical documentation in support of a novel image processing application. Provide user training. | • Detailed user-friendly document and importance of concise instructions.  
|                       |             | • Description of the methodology underpinning the image processing applications.  
|                       |             | • Limitations and errors of use of the imaging tool are documented and solved. |
SECTION 8: SPECIALIST LEARNING FRAMEWORK RADIATION SAFETY
STP Learning Framework

This section describes the Learning Framework for the Specialist Component of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Medical Physics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Radiation Safety Physics</td>
</tr>
</tbody>
</table>

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## RADIATION SAFETY PHYSICS – SPECIALIST MODULES

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<th>Risk Assessment and New Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (RADS2)</td>
<td>Diagnostic Radiology: Equipment Performance</td>
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<td>Module 3 (RADS3)</td>
<td>Patient Dose Assessment and Optimisation</td>
</tr>
<tr>
<td>Module 4 (RADS4)</td>
<td>Laser and Ultraviolet Equipment</td>
</tr>
<tr>
<td>Module 5 (RADS5)</td>
<td>Non-Ionising Sources: Radiation Risks, Safety and Bioeffects</td>
</tr>
<tr>
<td>Module 6 (RADS8)</td>
<td>Assess, Audit and Interpret Radiation Dose Monitoring</td>
</tr>
<tr>
<td>Module 7 (RADS7)</td>
<td>Radiation Governance Framework</td>
</tr>
<tr>
<td>Module 8 (RADS11)</td>
<td>Information and Communication Technology</td>
</tr>
</tbody>
</table>
MODULE 1 | Risk Assessment and New Facilities (RADS1) | COMPONENT | Specialist
--- | --- | --- | ---
AIM | To be able to risk assess a new radiation facility and advise on selection of equipment and room design. |  |
SCOPE | Diagnostic X-ray, Nuclear Medicine, Radiotherapy. |  |

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Assess risks associated with planned new facilities or services involving radiation.
2. Specify design features for new facilities or services involving the use of radiation.
3. Specify radiation protection and control features required for new facilities involving the use of radiation.
4. Develop local rules and contingency plans in conjunction with the radiation user for a new installation.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Participate in the procurement and evaluation processes of a new installation. This should include attendance at procurement/project team meetings, involvement in the purchasing of the new equipment, and specifying the shielding required for the facility. The trainee should be able to reflect on the balance between desirable and essential features, and the cost/benefit of equipment choice to the clinical service provided, including the impact on patient care.
- Perform a comparative review of current methods of shielding calculations and room design, including mathematical and computer models. The trainee should be able to reflect on the advantages and disadvantages of the differing approaches used, and assumptions made in the calculations including the impact on clinical service and on patient care.

It is also recommended that trainees undertake the following clinical experiential learning:

- Participate in the procurement and evaluation processes of a new installation in more than one modality.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Undertake risk assessment for a diagnostic radiology facility.</td>
<td>• Theory of risk assessment using current statutory and professional guidance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Radiation interactions with tissues and ingestion pathways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External exposure hazards, attenuation, scatter and ambient radiation fields.</td>
</tr>
<tr>
<td>1</td>
<td>Undertake risk assessment for a nuclear medicine facility.</td>
<td>• Theory of risk assessment using current statutory and professional guidance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hazards from unsealed sources, annual limits of intake, biokinetic models, properties of liquid sources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Radiation interactions with tissues and ingestion pathways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External exposure hazards, attenuation, scatter and ambient radiation fields.</td>
</tr>
<tr>
<td>1</td>
<td>Undertake risk assessment for a radiotherapy facility.</td>
<td>• Theory of risk assessment using current statutory and professional guidance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Radiation interactions with tissues and ingestion pathways.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• External exposure hazards, attenuation, scatter and ambient radiation fields.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Knowledge of High Activity Sealed Source regulations and anti-terrorism implications.</td>
</tr>
<tr>
<td>2,3</td>
<td>Undertake room design from first principles for a complex diagnostic X-ray facility (high-dose fluoroscopy or Computed Tomography) and specify the radiation design features.</td>
<td>• Operational design requirements. Practices and workloads.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Properties of radiation source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Properties of construction and shielding materials.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Layout and influence on radiation levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Design constraints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Protection of staff, members of the public and the environment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Methods for modelling radiation levels.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Engineering controls, safety and warning systems.</td>
</tr>
<tr>
<td>2,3</td>
<td>Undertake room design from first</td>
<td>• Operational design requirements. Practices and workloads.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
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</tr>
</tbody>
</table>
|                      | principles for a nuclear medicine facility and specify the radiation design features. | • Properties of radiation source.  
• Properties of construction and shielding materials.  
• Layout and influence on radiation levels.  
• Design constraints.  
• Contamination control by design.  
• Discharge pathways.  
• Protection of staff, members of the public and the environment.  
• Methods for modelling radiation levels.  
• Engineering controls, safety and warning systems.  
• Features limiting and controlling contamination. |
| 2,3                  | Undertake room design from first principles for a radiotherapy facility (and/or brachytherapy facility) and specify the radiation design features. | • Operational design requirements. Practices and workloads.  
• Properties of radiation source.  
• Properties of construction and shielding materials.  
• Layout and influence on radiation levels.  
• Consideration for neutron/activation products produced as a by-product.  
• Design constraints.  
• Contamination control by design.  
• Protection of staff, members of the public and the environment.  
• Methods for modelling radiation levels.  
• Engineering controls, safety and warning systems.  
• Application of High Activity Sealed Source regulations and anti-terrorism implications. |
<p>| 2,3                  | In conjunction with the user, develop the specification for the procurement of equipment to be used in a new facility. | • Clinical procedures, physical requirements, Personal Protective Equipment, mobile shielding, fixed shielding, quality assurance test equipment and phantoms. |
| 2,3                  | Develop criteria for the selection of new equipment for a modality and | • Clinical requirements, restriction of dose, dose-saving features, efficiency saving devices, physical size and positioning |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>participate in the procurement and evaluation process of a new facility.</td>
<td>requirements, dose indicators, dose recording devices.</td>
</tr>
<tr>
<td>3</td>
<td>Devise and undertake a critical examination for amendments made to shielding of the facility or a new facility.</td>
<td>• Assessing construction techniques for new rooms. • Protection of staff, members of the public and the environment. • Verification of design compared with the build.</td>
</tr>
<tr>
<td>4</td>
<td>In conjunction with the user, and using the results of the risk assessment, develop the local rules for a new facility.</td>
<td>• Risk assessment and clinical procedures that should be carried out, develop the system of work, Personal Protective Equipment, dosimetry and other requirements to ensure legal dose limits are not exceeded and As Low As Reasonably Practicable is implemented.</td>
</tr>
<tr>
<td>4</td>
<td>Critically appraise the local rules for a number of different types of radiation installations.</td>
<td>• Legislative requirements for Local Rules</td>
</tr>
<tr>
<td>4</td>
<td>Write a detailed contingency plan for dealing with radiation incidents involving sealed and unsealed sources.</td>
<td>• Risk assessment, devising a contingency plan, including monitoring and decontamination procedures, contamination control, adverse incident and emergency procedures, external dose-rate, Personal Protective Equipment, additional staff monitoring.</td>
</tr>
</tbody>
</table>
MODULE 2 | Diagnostic Radiology: Equipment Performance (RADS2) | COMPONENT | Specialist

**AIM**
To enable the trainee to manage the testing and performance of a wide range of diagnostic X-ray systems.

**SCOPE**
Diagnostic X-ray.

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Measure and record levels and characteristics of radiation.
2. Calibrate and test equipment that measures radiation.
3. Perform measurements appropriate to safety testing, commissioning and periodic routine testing of a wide range of diagnostic systems.
4. Devise an appropriate test schedule for safety testing, commissioning and routine testing for a diagnostic imaging system new to the trainee.
5. Devise and undertake the specification and evaluation of new diagnostic systems.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- In addition to working within the host department, the trainee should visit another diagnostic radiology physics department and compare test equipment, protocols and frequencies. This would enable the trainee to reflect on the procedures and test equipment in the host department, looking at best/poor practice in quality assurance.
- The trainee should compare and contrast available test equipment with regard to specifications and ease of use. This may also include a review of available calibration facilities and the procedures performed on calibration.
- The trainee should attend some multidisciplinary sessions with regard to expanding their clinical knowledge about the uses of ionising imaging.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 2                     | Decide on appropriate tests to apply to the assessment of the measuring device to ensure that it is performing according to its specified standard. | • Monitor specifications, the range of radiations they cover and performance.  
• Radiation characteristics.  
• The correct application of national guidance on testing of radiation monitors.  
• Requirements for traceability of standards.  
• Appropriate contractors to use.  
• Local procedures and work instructions.  
• Safe handling of sealed/unsealed radioactive sources.  
• Calibration factors.  
• Applicability of the results.  
• Range of dose rates and energies appropriate to clinical use. |
| 1                     | Undertake and/or arrange for tests to be carried out in an environment, and with facilities, that are appropriate and traceable to national standards. | |
| 2                     | Obtain and interpret the results of tests and calibrations and report on the performance on the equipment. | |
| 3                     | Operate and perform routine quality assurance measurements safely on simple X-ray equipment for quality assurance (e.g. dental, mobile and general radiography), using a range of image detector technologies. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Awareness of different designs, e.g. table and wall buckies, mobile systems, chest radiography systems.  
• Different types of detector systems, theory of image capture and production.  
• Film screen systems, computed radiography and digital radiography. Appropriate test protocols for different detector systems.  
• Principle of projection radiography.  
• Technology behind different test equipment.  
• Current national quality assurance (QA) guidance. |
| 3,5                   | Perform commissioning and acceptance tests on simple X-ray equipment and detectors. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Operate and perform routine quality assurance measurements safely on mammography equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Awareness of the differences in design between mammography and general equipment in the context of choosing the correct test equipment and appropriate test protocols.  
• Different types of detector systems.  
• Current national QA guidance. |
| 3,5                   | Perform commissioning and acceptance tests on mammography equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals. |
| 3                     | Operate fluoroscopy systems and perform appropriate routine QA measurements safely. | • Awareness of different designs, C-arm, under- or over-table tubes, bi-plane rooms, mobile units.  
• Current national QA guidance. |
| 3,5                   | Perform commissioning and acceptance tests on fluoroscopy equipment. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Commissioning specific tests.  
• Engineering safety features.  
• Appropriate warning signs and signals.  
• Scatter measurements. |
| 3                     | Safely operate Computed Tomography systems and perform appropriate routine QA measurements. | • Safe operation of equipment.  
• The implications of unsafe performance for staff and patients.  
• Practical use of dosimetric quantities such as the Computed Tomography Dose Index measured at the centre of rotation (CTDIcon) and the weighted Computed Tomography Dose Index (CTDIw).  
• Basic theoretical knowledge of the image production.  
• Effect of kV and reconstruction kernel on the images obtained for |
<table>
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<tr>
<th>KEY LEARNING OUTCOMES</th>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 3,5                   | Perform commissioning and acceptance tests on Computed Tomography X-ray equipment. | QA.  
  - Current national QA guidance.  
  - An awareness of the different modes of operation of Computed Tomography scanners, including axial, helical, dual energy and fluoroscopy imaging.  
  - Relevance of different methods of operation to clinical use.  
  - Potential for difference in results according to mode of operation. |
| 4                     | Devise test schedule for a diagnostic imaging system new to the trainee. | Safe operation of equipment.  
  - The implications of unsafe performance for staff and patients.  
  - Commissioning specific tests.  
  - Engineering safety features.  
  - Appropriate warning signs and signals.  
  - Scatter measurements. |
  - Clinical use of equipment.  
  - Appropriate choice of clinical user tests and test equipment.  
  - Risk management – cost/benefit. |
| 4                     | Critically review safety performance programmes and make recommendations if appropriate. | Likelihood of and prevalence of risks and the impact on patient safety, experience and care. |
| 5                     | Devise and undertake a critical examination for complex equipment, for example a cardiac intervention suite or Computed Tomography scanner. | Equipment parameters that may affect safe use and mechanisms of testing. Interlocks and engineering controls used to restrict exposure.  
  - The risks associated with the clinical operation of the equipment and the importance and function of relevant interlocks and safety features and the implications for staff and patients. |
<table>
<thead>
<tr>
<th>MODULE 3</th>
<th>Patient Dose Assessment and Optimisation (RADS3)</th>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM</td>
<td>To enable the trainee to undertake the assessment of patient dose and implement interventions to optimise imaging systems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCOPE</td>
<td>Diagnostic X-ray.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

**On successful completion of this module the trainee will:**

1. Audit patient doses for a range of examinations.
2. Undertake an assessment of patient dose and image quality in a complex imaging system and propose optimisation strategies.
3. Perform appropriate measurements and/or calculations to assess patient dose for a range of examinations, which must include examples from radiographic, fluoroscopic, Computed Tomography and mammographic examinations.
4. Analyse patient dose measurements and, in the context of optimisation, draw conclusions.
5. Assess, by simulation and/or measurement, patient dose reduction interventions.
6. Calculate organ dose and effective dose, relate dose to risk and effectively communicate the risk.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Assess clinical image quality using appropriate parameters with a multidisciplinary team. This may also include optimisation of the images and calculation of the patient doses involved.
- Critically appraise parameters measured for image quality and patient dose for one modality, with respect to previous results and clinical impact.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Review and critically appraise the patient dose measurement framework.</td>
<td>• National guidance on patient dose measurement and audit.</td>
</tr>
<tr>
<td>1</td>
<td>Carry out an audit of patient dose looking at factors that influence the results, e.g. equipment, operators.</td>
<td>• National patient dose guidance and protocols and correct application.</td>
</tr>
<tr>
<td>2</td>
<td>Undertake measurements of patient dose/image quality in complex imaging systems.</td>
<td>• National QA guidance and its correct application. • Fluoroscopy test objects. • Clinical reasons for high image quality. • NHS Breast Screening Programme documentation and its correct completion. • Use of different available test objects in clinical situation. • Computed Tomography image quality (IQ) phantoms. • Appreciation of the effect of Kernel and slice thickness on image quality parameters. • Image quality/patient dose trade-off. • Effect of exposure parameters on image quality and patient dose, including paediatric dose.</td>
</tr>
<tr>
<td>3,5</td>
<td>Review the outcome of patient dose/image quality measurements in a range of modalities and recommend optimisation strategies. Assess by simulation or measurement the effect of the optimisation suggested.</td>
<td>• National and international guidance and correct application. • Assumptions behind the calculations. • National/local procedures for setting Diagnostic Reference Levels. • Mammography dose calculation software. • ImPACT dose calculator software. • Assumptions behind the calculations.</td>
</tr>
<tr>
<td>3</td>
<td>Calculate patient doses for plain film radiography for a range of common clinical examinations.</td>
<td>• National and international guidance and correct application. • Assumptions behind the calculations. • National/local procedures for setting Diagnostic Reference Levels. • Mammography dose calculation software. • ImPACT dose calculator software. • Assumptions behind the calculations.</td>
</tr>
<tr>
<td>3</td>
<td>Calculate patient doses for women who have had mammography X-ray imaging.</td>
<td>• National and international guidance and correct application. • Assumptions behind the calculations. • National/local procedures for setting Diagnostic Reference Levels. • Mammography dose calculation software. • ImPACT dose calculator software. • Assumptions behind the calculations.</td>
</tr>
<tr>
<td>3</td>
<td>Calculate patient doses for patients who have had Computed</td>
<td>• National and international guidance and correct application. • Assumptions behind the calculations. • National/local procedures for setting Diagnostic Reference Levels. • Mammography dose calculation software. • ImPACT dose calculator software. • Assumptions behind the calculations.</td>
</tr>
<tr>
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<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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<tr>
<td>Tomography X-ray imaging.</td>
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<tr>
<td>4</td>
<td>Develop local Diagnostic Reference Levels based on patient dose calculations.</td>
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</tr>
</tbody>
</table>
| 3,6                   | Calculate organ and effective doses for a range of examinations in different modalities, including nuclear medicine. | National and international guidance and correct application.  
Methods of internal dosimetry in nuclear medicine. |
| 4,6                   | Assist with the explanation of the significance of the results of a patient dose audit and make recommendations for action to reduce doses where appropriate. | Expected doses, effect of reduction in patient dose on clinical outcomes, national guidance and survey results and Diagnostic Reference Levels. |
| 4                     | Investigate the circumstances of an unusual patient dose. | Expected doses, national guidance and survey results, and Diagnostic Reference Levels and correct application. |
| 4,6                   | Communicate actual and potential risks from patient exposures, in context, to other healthcare professionals and members of the public. | Relative risks, national and international guidance.  
Information needs of healthcare professionals.  
Common questions asked by healthcare professionals. |
| 4                     | Participate in a dose and risk assessment for a research exposure, taking into account age, sex and life expectancy. | Ethics guidance.  
Methods of applying for research exposures.  
Justification of research exposures.  
Definition of research exposures.  
Legal requirements (e.g. Administration of Radioactive Substances Advisory Committee, Ionising Radiation (Medical Exposures) Regulations 2000). |
<table>
<thead>
<tr>
<th>MODULE 4</th>
<th>Lasers and Ultraviolet Equipment (RADS4)</th>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM</td>
<td>The trainee can participate in measurements to characterise a range of non-ionising (non-imaging) radiation sources.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCOPE</td>
<td>Ultraviolet, lasers, therapeutic ultrasound.</td>
<td></td>
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</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Identify an appropriate monitor that has a suitable sensitivity, range of use and in-date calibration.
2. Perform experiments to reduce uncertainty.
3. Provide recommendations on non-ionising radiation use based on measured output and published recommendations.
4. Interpret the readings of monitors and detectors.
**CLINICAL EXPERIENTIAL LEARNING**

The clinical experiential learning for this module is:

- The trainee should perform a literature review of the clinical uses of non-ionising radiation. This may include blue light therapy, Ultraviolet, lasers, short-wave diathermy, therapeutic ultrasound, e.g. lithotripsy, physiotherapy ultrasound and high-intensity focused ultrasound (HIFU).

It is also recommended that trainees undertake the following clinical experiential learning:

- Attend an Ultraviolet or laser treatment session.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
</table>
| 1                     | Carry out an inter-comparison of non-ionising radiation monitors. | • Types of radiation monitor.  
• Suitability of different monitors. |
| 1,2,3,4               | Perform QA and safety of Ultraviolet systems, including eyewear. | • Biohazards of Ultraviolet, acute and chronic.  
• Types of Ultraviolet cabinets.  
• National guidance and legislation.  
• National QA guidance.  
• Measurements of irradiance with and without patient (or simulator). |
| 3                     | Perform QA and safety assessments of a laser in clinical use. | • Laser types, wavelengths and classification.  
• Biohazards of lasers, burns, eye damage, laser fume.  
• Electrical hazards and chemical hazards.  
• National and International Guidance and Legislation.  
• Local rules, nominated users, Laser Protection Adviser, Laser Protection Supervisor.  
• Measurement of power outputs. |
| 4                     | Calculate nominal ocular hazard distance (NOHD) and advise on suitable eye protection. | • Laser types, wavelengths and classification.  
• National and international guidance and legislation.  
• Biohazards of lasers, maximum permissible exposure for eye damage. |
LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Undertake non-ionising radiation risk assessment, demonstrating an understanding of the control measures available to ensure safe practice.
2. Provide safety information to staff, patients and their carers.
3. Calculate estimated exposures to patients and staff.
4. Undertake a room risk assessment for a non-ionising radiation facility.
5. Explain modality specific risks and the relevant exposure limits.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Participate in clinical audit of non-ionising radiation. Discuss your experience with your supervisor, including the importance of audit to clinical practice.
- Participate in at least one of the optional clinical experiential learning episodes.
- Observe the clinical use of surgical lasers in a range of different specialities. The trainee should be able to reflect on the type of laser used for the clinical procedure and the safety considerations that can be applied for staff and patients.
- Observe the clinical use of Ultraviolet. The trainee should be able to reflect on the type of Ultraviolet cabinet used for the clinical procedure and the safety considerations that can be applied. Typical exposure times should also be noted. The trainee should reflect and discuss the implications for patient care.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Critically review policies and procedures for compliance with non-ionising radiation protection legislation and guidance.</td>
<td>• National and international guidance and legislation for non-ionising radiations, employer’s policies and procedures, and correct application.</td>
</tr>
<tr>
<td>1,4</td>
<td>Undertake a risk assessment for a clinical laser or Ultraviolet practice and make recommendations regarding safe operating procedures.</td>
<td>• National and international guidance and legislation for non-ionising radiations and correct application. • The range of risks and their relative significance for staff and patients.</td>
</tr>
<tr>
<td>2</td>
<td>Write local rules or guidance notes for a clinical laser and Ultraviolet practice.</td>
<td>• National and international guidance and legislation for non-ionising radiations and correct application.</td>
</tr>
<tr>
<td>2</td>
<td>Assess the requirements for Personal Protective Equipment and make recommendations with regard to the specifications of Personal Protective Equipment.</td>
<td>• Methods of calculating Personal Protective Equipment specification.</td>
</tr>
<tr>
<td>2</td>
<td>Collect data for the calculation of exposure to patients.</td>
<td>• National and international guidance and legislation for non-ionising radiations, understand the methods and equipment used for monitoring non-ionising exposure, clinical protocols and correct application.</td>
</tr>
<tr>
<td>2,5</td>
<td>Provide training to a relevant staff group on the implementation of radiation safety practices.</td>
<td>• The clinical standard operational procedures, relevant legislation and guidance, safety equipment and correct application of operational radiation safety practice, local and national e-learning facilities.</td>
</tr>
<tr>
<td>3</td>
<td>Carry out measurements of occupational exposure for a source of non-ionising radiation.</td>
<td>• Exposure meters, wavelengths, divergence effects, exposure calculations. • National and international regulations and guidance.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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<tr>
<td>4</td>
<td>Perform and report on non-ionising radiation protection audits.</td>
<td>• National and international guidance and legislation for non-ionising radiations, employer’s procedures and correct application.</td>
</tr>
</tbody>
</table>
| 1,4                  | Critically appraise risk assessments and safe operating procedures for clinical Magnetic Resonance Imaging and ultrasound. | • National and international guidance and legislation for non-ionising radiations and correct application.  
• The range of risks and their relative significance for staff and patients. |
| 5                    | Demonstrate understanding in environmental exposure to non-ionising radiation. | • Public concerns with Non-Ionising Radiation, e.g. microwaves, Radio Frequency electromagnetic fields, mobile phones.  
• The impact of exposure on patient care and public concerns. |
<table>
<thead>
<tr>
<th>MODULE 6</th>
<th><strong>Assess, Audit and Interpret Radiation Dose Monitoring (RADS8)</strong></th>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM</td>
<td>The trainee can assess environmental radiation monitoring results, staff doses and workplace monitoring, including doses to members of the public and the radiological impact in the environment.</td>
<td></td>
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</tr>
<tr>
<td>SCOPE</td>
<td>Diagnostic X-ray, nuclear medicine.</td>
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</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Audit and interpret environmental radiation monitoring results.
2. Audit and interpret staff dosimetry and workplace monitoring results.
3. Undertake radiological impact assessments
4. Assess radiation doses to members of the public.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- The trainee should participate in environmental and personnel monitoring programmes.
- The trainee should participate in an investigation of an accidental patient exposure. They should be involved in the investigation of how the accident occurred, what dose the patient received, and any procedures with respect to reporting the dose, either internally or externally. It may also be applicable to determine the risk caused by the accidental radiation exposure. The trainee should reflect on the lessons learned to prevent the accident happening again, and the patient experience in this occurrence.
- The trainee should participate in an audit of radioactive substances activities in relation to Environmental Permitting Regulations compliance and other relevant legislation, or be involved with variation of a permit.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
<tbody>
<tr>
<td>1,2</td>
<td>Plan and carry out environmental monitoring around a designated radiation area and assess any implications for staff, patients and/or public.</td>
<td>• Methods of measuring environmental doses, e.g. radiation monitors, Thermo-Luminescent Dosimetry, film, solid state detectors, etc., contamination monitoring, correct selection of instrumentation.</td>
</tr>
<tr>
<td>1,2</td>
<td>Determine a projected dose over a suitable period of time, taking into account likely occupancy of areas where there is an exposure risk.</td>
<td>• Workloads, exposures, clinical procedures, instantaneous dose rate and time-averaged dose rate measurements.</td>
</tr>
<tr>
<td>1,2</td>
<td>Assess potential doses from the use of sealed and unsealed sources and methods of ensuring safe practices.</td>
<td>• Clinical operation and use of sources, typical dose rates, potential internal and external dosimetry, including contingency arrangements.</td>
</tr>
<tr>
<td>3</td>
<td>Critically appraise the framework for controlling radioactive materials using best available techniques.</td>
<td>• Legislation and guidance, modelling methodologies, radiation exposure routes.</td>
</tr>
<tr>
<td>1,3</td>
<td>Assess the radiological impact of radioactive waste disposal.</td>
<td>• Critical dose groups.                                                                avery available techniques.</td>
</tr>
<tr>
<td>2</td>
<td>Identity the groups of staff, including vulnerable groups, e.g. pregnant staff, who are likely to be exposed to radiation arising from a procedure and decide on appropriate system of dose assessment.</td>
<td>• Clinical procedures, occupancy, types of personal dosimeter, areas of body most at risk, sensitivity and accuracy of dosimeters, legislation and guidance.</td>
</tr>
<tr>
<td>2</td>
<td>Review and critically appraise the personal dosimetry framework for the staff groups identified.</td>
<td>• Legislation and guidance, range of personal dosimetry options, identify the types of radiation likely to be involved in any exposure of the public. The importance of agreeing the identity of the groups of staff or members of the public who are likely to be exposed to radiation arising from the work of the organisation.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
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<td>KNOWLEDGE AND UNDERSTANDING</td>
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</tr>
<tr>
<td>2</td>
<td>Make recommendations with regard to routine dose monitoring, personal protection, classification and dose reduction.</td>
<td>• Methods of dose reduction, legislation and guidance.</td>
</tr>
<tr>
<td>2</td>
<td>Review results of routine personal monitoring and investigate an abnormal result.</td>
<td>• Legal limits, action levels and understand the assessment of dose using personal dosimeters.</td>
</tr>
<tr>
<td>4</td>
<td>Identify types of radiation likely to be involved in any exposure to the public, determine the means of assessment and make dose assessments where applicable.</td>
<td>• Naturally occurring radiation, artificial sources of radiation.</td>
</tr>
<tr>
<td>4</td>
<td>Communicate actual and potential risks from radiation, in context, to other healthcare professionals and members of the public.</td>
<td>• The significance of risks for staff, patients and the public. • The information needs of healthcare professionals and public.</td>
</tr>
</tbody>
</table>
## MODULE 7

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AIM</strong></td>
<td>To understand the management of radiation safety in a healthcare organisation.</td>
</tr>
<tr>
<td><strong>SCOPE</strong></td>
<td>Diagnostic radiology, nuclear medicine and radiotherapy.</td>
</tr>
</tbody>
</table>

### LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Develop organisational policies for radiation protection.
2. Develop procedures for management and control of radioactive substances.
3. Develop procedures for control of equipment generating radiation and of the radiation emitted.
4. Audit areas where radiation is used.
5. Participate in the response to radiation incidents and emergencies.
**CLINICAL EXPERIENTIAL LEARNING**

The clinical experiential learning for this module is:

- The trainee should attend the radiation safety committee and/or medical exposures committee, with a view to observing how the management of radiation protection takes place in practice. They should be able to contribute to some of the discussions, as appropriate, and reflect on the sometimes contentious issues discussed.
- The trainee should prepare an audit of radiation areas using existing audit tools (which the trainee should critically appraise as part of the process) or by developing new tools. The trainee will need to understand relevant legislation and guidance and the processes that are being undertaken in the areas being audited. The audit should address areas of significance for patient care and the future practice in the area being audited. The trainee should use the above audit tool to assess a radiation area and issue a written report giving appropriate advice and recommended actions.
- The trainee should participate in the investigation of a radiation incident where a patient has been given a greater than intended dose or a member of staff has accidentally received a radiation dose. The trainee should be involved in determining why the incident occurred, the dose received and the steps taken to reduce the likelihood of recurrence. They should also reflect on the patient’s experience.
- The trainee should review radiation incident plans at organisation level and specific department plans. The trainee should critically appraise the plans, including a review of the contents of the radiation incident kit (equipment, documentation, guidance publications).

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| **1**                 | Critically appraise the organisation’s radiation safety policies with reference to the current legislation. | • Radiation legislation and guidance, communications and reporting structures.  
                        |                                                                             | • The range, extent and location of facilities using radiation.  
                        |                                                                             | • Radiation duties in the management structure, entitlement.  
                        |                                                                             | • The legal role of the Radiation Protection Supervisor, delegation of employer’s duties, appointment of key personnel (e.g. Radiation Protection Adviser, Radioactive Waste Adviser, Ionising Radiation (Medical Exposures) Regulations 2000 duty holders).  
                        |                                                                             | • Terms of reference for a radiation safety committee/medical exposures committee, including the constitution.  
                        |                                                                             | • Management procedures for the control of radioactive substances and the control of radiation equipment. |
| **2**                 | Draft or critically appraise local rules and procedures for departments using radioactive materials, including contingency plans, consulting with users where appropriate. | • Radiation legislation and guidance and correct application.  
                        |                                                                             | • Information needs of departments.  
                        |                                                                             | • Range of users. |
| **3**                 | Draft or critically appraise local rules and procedures for departments using equipment that generates radiation, including contingency plans, consulting with users where appropriate. | • Radiation legislation and guidance and correct application.  
                        |                                                                             | • Information needs of departments.  
                        |                                                                             | • Range of users. |
| **4**                 | Draft or critically appraise Ionising Radiation (Medical Exposures) Regulations 2000 procedures for a department using ionising radiation or radioactive materials. | • Radiation legislation and guidance and correct application.  
                        |                                                                             | • Information needs of departments.  
<pre><code>                    |                                                                             | • Range of users. |
</code></pre>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1,2                   | Plan, prepare and undertake audits in a range of facilities, applying suitable methodology for the type of audit to be conducted. | • Aims of audit.  
• Relevant risks.  
• Legislation and guidance and correct application.  
• Audit pro forma for a range of radiation installations.  
• Issues to be reviewed and record keeping requirements including:  
  • risk assessments  
  • staff responsibilities and entitlements  
  • records for usage, monitoring, contamination, decontamination, stock, disposals of radioactive materials  
  • records of QA testing  
  • records of accidents and incidents  
  • local rules and staff signatures  
  • fault logs, handover records and maintenance schedules  
  • staff training records  
  • Ionising Radiation (Medical Exposures) Regulations 2000 procedures  
  • staff dose records  
  • investigation of doses above the investigation limits  
  • environmental monitoring records. |

| 1,2                   | Report findings of risk assessment audit, specify degree of compliance, recommendations for further action and date of follow-up review. | • Organisation policies and procedures for audit.  
• Legislation and guidance.  
• Scientific and technical report writing.  
• The implications of non-compliance on patient safety and care. |

|                      | Participate in the investigation of a radiation incident. | • Legislation and guidance and correct application.  
• Requirements for external reporting of doses much greater than intended.  
• Reporting arrangements to external agencies (e.g. Health & Safety Executive, Care Quality Commission, Environment Agency, |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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</tr>
</thead>
</table>
| 3,5                  | Perform measurements or calculations to establish the extent to which radiation exposure has taken place and therefore the risks posed. | • Appropriate use of radiation monitoring instruments.  
• National and international guidance.  
• Radiation exposure routes. |
| 1,2                  | Report results of incident investigation in correct format and at required level of detail for target audience, including a recommended action plan. | • Methods of clear and concise communication.  
• Scientific and technical writing.  
• National legislation, national and international guidance and correct application.  
• Level of education and training of target audience in radiation safety.  
• Hierarchy of controls.  
• Remove the risk.  
• Engineering controls.  
• Systems of work.  
• Personal protective equipment. |
| 1,2                  | Review plans and action cards to be used in the event of a major radiation incident. | • Emergency response and employer's emergency procedures.  
• National legislation, national and international guidance. |
| 1,2                  | Audit equipment available for use in a major radiation incident and ensure that the appropriate radiation monitors would be available. | • Awareness of means of ensuring personnel protection and methods of preventing spread of contamination.  
• Appropriate radiation monitoring equipment.  
• National Arrangements for Incidents involving Radioactivity (NAIR) scheme. |
| 1,2                  | Participate in the training of staff with regard to major radiation incidents. | • Radiation risk communication to a range of learners with different needs.  
• Methods of clear and concise communication.  
• Level of education and training of target audience in radiation safety. |
 MODULE 8  | Information and Communication Technology (RADS11)  | COMPONENT  | Specialist
---|---|---|---
AIM | Understand the radiation safety and diagnostic imaging implications of information and communication technology (ICT) processes. | 
SCOPE | Ionising and non-ionising radiation safety. The trainee will be able to discuss the information governance and operational management requirements for clinical systems, and the ICT infrastructure requirements for a diagnostic imaging service, including networking and interconnectivity. | 

**LEARNING OUTCOMES**

*On successful completion of this module the trainee will:*

1. Comply with the information governance and operational management requirements for clinical systems.
2. Identify the ICT infrastructure requirements for services using ionising radiation, including networking, data storage and interconnectivity.
3. Develop, validate and/or verify a novel radiation safety application.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- The trainee should use relevant software and/or spreadsheets to carry out radiation safety assessments (e.g. room shielding, patient radiation dose estimation). The trainee should be able to reflect on the ICT options available to facilitate a particular task. The trainee should include some analysis of the magnitude of errors introduced by using the different options.
- The trainee should develop or critically appraise a spreadsheet or piece of software that is used. The trainee should be able to demonstrate an understanding of how the spreadsheet or software works. The trainee should be able to discuss an appropriate commissioning/QA programme for the software.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Critically appraise the information governance and operational management requirements for patient and staff data. | • Organisation information governance requirements with links to national legislation.  
• Operational management requirements for critical systems.  
• Best practice guidance and legislation. |
| 1,2                   | Appraise the radiation safety implications of ICT processes, e.g. RIS, PACS, electronic requesting and prescription. | • Best practice guidance and legislation.  
• Paper versus non-paper systems.  
• Identification of points of weakness and mitigation of risks. |
| 3                     | Specify, develop and validate the use of novel spreadsheets or software for radiation safety calculations. | • Document control for the production of novel systems.  
• Commissioning of new systems. |
| 1                     | Review data security for sensitive information. | • National guidance and legislation.  
• Password protection, encryption, authorised access, secure communication, back-up. |
 SECTION 9: SPECIALIST LEARNING FRAMEWORK
RADIOTherapy PHYSICS
### STP Learning Framework

This section describes the Learning Framework for the **Specialist Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

#### Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Medical Physics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Radiotherapy Physics</td>
</tr>
</tbody>
</table>

- **DIVISION**: Physical Sciences and Biomedical Engineering
- **THEME**: Medical Physics
- **SPECIALISM**: Radiotherapy Physics
RADIOTHERAPY PHYSICS – SPECIALIST MODULES

<table>
<thead>
<tr>
<th>Module 1 (RP1)</th>
<th>Dosimetry and Treatment Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (RP2)</td>
<td>Treatment Planning</td>
</tr>
<tr>
<td>Module 3 (RT3)</td>
<td>Brachytherapy</td>
</tr>
<tr>
<td>Module 4 (RT4)</td>
<td>Computing Related to Radiotherapy</td>
</tr>
<tr>
<td>MODULE 1</td>
<td>Dosimetry and Treatment Equipment (RP1)</td>
</tr>
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<td>----------</td>
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</tr>
<tr>
<td><strong>AIM</strong></td>
<td>To provide the trainee with development and experience in the performance of measurements relating to radiotherapy treatment and interpretation of results.</td>
</tr>
<tr>
<td><strong>SCOPE</strong></td>
<td>At the end of this module the trainee will be able to perform a range of measurements associated with a treatment beam and to ensure that equipment is suitable and ready for clinical use. They will understand and apply the relevant codes of practice and be able to perform limited patient-specific treatment and analysis.</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Perform required measurements to characterise a treatment beam.
2. Perform required measurements to establish a treatment machine is suitable for clinical use.
3. Interpret results and instigate corrective action where required.
4. Apply the appropriate codes of practice.
5. Perform patient-specific quality assurance and in-vivo dosimetry and analyse the results.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Discuss the importance, application and relevance of routine quality assurance to patient care and treatment.
- Discuss the importance of external dosimetry audits and how this can be used to inform clinical practice.
- Identify and discuss the risks associated with the introduction of new equipment, with reference to how the commissioning process mitigates the risk.
- Develop a protocol for a new technique or piece of equipment and present to your supervisor and colleagues with rationale and implications for patient and service benefits.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
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</table>
| 1,2,4                 | Measure the depth dose curves and profiles of a MV photon beam and evaluate the effect of chamber design. | • Characterisation of the photon depth dose curves and profiles and the effect of varying machine parameters.  
• Choice of the appropriate chamber.  
• Use of a plotting tank and other measurement media (i.e. solid water). |
| 1,2,4                 | Measure the depth ionisation curves and profiles of an electron beam and, with reference to the code of practice, evaluate the effect of chamber design. Determine the depth dose curve. | • Characterisation of the electron curves and profiles.  
• Choice of the appropriate chamber.  
• Use of a plotting tank and other measurement media (i.e. solid water). |
| 4                     | Use the relevant codes of practice (kV, MV, electrons), including traceability, and establish the required factors, including performing inter-comparisons, and compare with the current values. | • The physics of dosimetry.  
• All the codes, their need and application.  
• Associated uncertainties within the calibration process and the impact on clinical dosimetry.  
• Appreciation of stability of calibration factors used in the department and their impact on dose prescribing.  
• Definitions of the various factors and understanding of required measurement processes.  
• Chamber construction and its relevance to these factors.  
• Codes of practice. |
| 1,2,4                 | Evaluate the beam profile and dose output for a kV machine. | • Intensity profile and heel effect in relation to the profile.  
• Appropriate code of practice. |
| 2,3,4                 | Perform routine quality assurance (QA) on treatment machines, including MV and kV imaging as appropriate. | • National recommendations from professional bodies and guidance notes for relevant legislation.  
• Local implementation of quality control (QC) schedules within the departmental quality process and associated documentation. |
<table>
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<tr>
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>• Origin of the parameters that are checked (i.e. the connection to commissioning).</td>
</tr>
</tbody>
</table>
| 2,3,4                | Perform QA on imaging equipment used for radiotherapy (e.g. CT, MRI, kV, as appropriate), | • National recommendations from professional bodies and guidance notes for relevant legislation.  
• Local implementation of QC schedules within the departmental quality process and associated documentation.  
• Origin of the parameters that are checked (i.e. the connection to commissioning). |
| 1                    | Perform measurements or calculations to compare a fixed SSD calculation system with an isocentric system. | • Differences between percentage depth dose (PDD) and tissue maximum ratio (TMR)/ tissue–phantom ratio (TPR) and knowledge of the relationship between them and the requirements to be able to measure them. |
| 2,3                  | Assist in the correction of the calibration of the dose delivery system and the beam parameters on a Linac. | • Relevant part of a Linac control system.  
• Accepted practice (relation to guidance notes and accepted professional practice), i.e. who should be involved. |
| 3                    | Assist in the correction of out-of-tolerance results for mechanical movements (e.g. field size). | • Relevant part of a Linac control system.  
• Accepted practice (relation to guidance notes and accepted professional practice), i.e. who should be involved. |
| 1,2,4                | Assist with the practical aspects of commissioning new treatment machines/techniques or revalidate the data in use, e.g. by selecting an appropriate detector, acquiring beam data and critically appraising with respect to reference data. | • Recommended practice (professional body and other guidance) related to commissioning of equipment, i.e. prior risk assessment and critical examination.  
• Manufacturer’s acceptance procedures and departmental processes, i.e. based on risk assessment regarding the equipment use.  
• In-depth knowledge of beam production and delivery equipment and systems. |
<p>| 5                    | Perform patient-specific QA | • QA for complex treatments, e.g. intensity-modulated radiation |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
<td>checks for complex treatment plans.</td>
<td>therapy intensity-modulated radiation therapy (IMRT) and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>continuous arc therapy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Setting up the treatment machine for complex treatments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Different approaches to delivery of complex treatments.</td>
</tr>
<tr>
<td>MODULE 2</td>
<td>Treatment Planning (RP2)</td>
<td>COMPONENT</td>
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<tr>
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</tr>
<tr>
<td><strong>AIM</strong></td>
<td>To provide development and experience in treatment planning for radiotherapy treatments, including planning, quality assurance and provision of advice.</td>
<td></td>
</tr>
<tr>
<td><strong>SCOPE</strong></td>
<td>On completion of this module, the trainee will understand the potential and limitations of the available planning systems and will be able to undertake quality assurance of the full treatment-planning process. They will develop their capacity to provide advice on treatment planning and in analysis of treatment techniques and effectiveness.</td>
<td></td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Plan all but the most complex cases.
2. Check calculations and standard plans.
3. Provide and analyse in-vivo dosimetry data.
4. Provide advice on treatment techniques.
5. Analyse effectiveness of treatment plan delivery.
6. Understand the appropriate use of treatment-planning algorithms.
7. Quality assure the whole treatment-planning process.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Follow the progress of the patient from the referral to the end of treatment and reflect on your learning from this process.

It is also recommended that trainees undertake the following clinical experiential learning:

- Participate in the commissioning of planning technique and system and reflect on the uncertainties of treatment planning with respect to treatment delivery.
- Produce a case-based study of a complex planning technique used in the local department, to include evaluation of the technique in terms of its applicability, effectiveness and benefits to patient treatment.
- Perform a case study of an ongoing clinical trial. Reflect on and review the process and outcomes in terms of the interaction between Radiotherapy Physics and other specialisms to improve patient care.
- Participate in planning team meetings and report on the process and outcomes in terms of the contribution of this process to improvements and innovation in service delivery and the impact on improved patient treatment.
- Participate in the resolution of clinical queries at all stages of the patient pathway and discuss possible solutions to ensure successful patient delivery.
- Attend a multidisciplinary meeting and reflect on the way the multidisciplinary team contributes to the care of patients undergoing radiotherapy treatment.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</thead>
<tbody>
<tr>
<td>6</td>
<td>Identify and review types of treatment-planning algorithms, explaining the effect of the choice on clinical treatment plans.</td>
<td>• Treatment-planning algorithms and relative accuracy in different clinical situations.</td>
</tr>
</tbody>
</table>
| 4,5                  | Audit and critically appraise a departmental treatment planning procedure. | • Requirement of the department’s quality system.  
• Ionising Radiation (Medical Exposures) Regulations 2000.  
• Justification and optimisation as applied to radiotherapy. |
| 1,5                  | Perform image registration using available software Computed Tomography (CT) to CT, Magnetic Resonance Imaging (MRI) to CT, Positron emission tomography (PET) to CT, critically evaluate results of image registration and explain any shortcomings of each imaging method and the registration technique. | • Limitations of different imaging modalities used in radiotherapy systems and registration techniques used in the chosen systems. |
| 1                    | Generate outlines for anatomical structures and International Commission on Radiation Units and Measurements (ICRU) volumes for complex situations. | • Relevant International Commission on Radiation Units and Measurements reports.  
• Volume growing tools and systems.  
• Computed Tomography anatomy and organs at risk applied to radiation therapy planning.  
• Image display device settings and their effect on volume definition and professional body recommendations. |
| 1,4,5                | Plan and critically assess non-routine/complex treatments (e.g. intensity-modulated radiation therapy (IMRT), craniospinal | • Different delivery techniques and their applications to clinical situations.  
• Objectives and constraints of different techniques.  
• Optimisation of treatment plans. |
<table>
<thead>
<tr>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>irradiation, total body irradiation, Stereotactic radiosurgery (SRS),</td>
<td>• Use of treatment-planning algorithms in different circumstances</td>
</tr>
<tr>
<td></td>
<td>Stereotactic body radiation therapy (SABR).</td>
<td>• Radiobiology underpinning different treatment protocols.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tumour control probability.</td>
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<tr>
<td></td>
<td></td>
<td>• Dose volume histogram analysis.</td>
</tr>
<tr>
<td>2</td>
<td>Undertake independent monitor unit calculations and critically appraise the results.</td>
<td>• Meaning of and need for independent monitor unit checks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Limitations of different treatment algorithms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local procedures.</td>
</tr>
<tr>
<td>4,5</td>
<td>Identify the course of action to be taken should a plan become clinically unsuitable during treatment (e.g. changes of shape, position, etc.).</td>
<td>• Local verification of patient set-ups and derivation of local tolerances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Procedures to carry out when out of tolerance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Systems in place for verification and patient set-up.</td>
</tr>
<tr>
<td>1,4</td>
<td>Advise on the use of electron beams taking into account energy, applicators, appropriate field size, cut-outs, changes of FSD, use of bolus, etc.</td>
<td>• Use of clinical use of electrons.</td>
</tr>
<tr>
<td>4,5</td>
<td>Calculate biological effective doses for different fractionation regimens for tumours and organs at risk.</td>
<td>• Correction strategies for treatment gaps.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local procedures.</td>
</tr>
<tr>
<td>4,5</td>
<td>Analyse the dosimetric effect of an error in the treatment process and propose a correction strategy.</td>
<td>• Compensation methods employed for geometric and dosimetric errors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reporting procedures.</td>
</tr>
<tr>
<td>5</td>
<td>Calibrate in-vivo dosimetry</td>
<td>• The requirements for in-vivo dosimetry.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>equipment</td>
<td>• In-vivo dosimetry equipment and their characteristics.</td>
</tr>
<tr>
<td>5</td>
<td>Undertake in-vivo dosimetry during patient treatments.</td>
<td>• The impact of in-vivo dosimetry on the need to re-plan treatments.</td>
</tr>
<tr>
<td>3</td>
<td>Analyse in-vivo dosimetry measurements.</td>
<td>• Local procedures and procedures for corrective action.</td>
</tr>
</tbody>
</table>
MODULE 3  Brachytherapy (RP3)  COMPONENT  Specialist

AIM  To develop the trainee’s knowledge and experience in planning and quality assurance associated with brachytherapy.

SCOPE  On completion of this module the trainee will have a working knowledge and understanding of the legislative requirements and local guidelines associated with brachytherapy. They will be able to plan patient treatments effectively and perform calculations associated with distribution of sources.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Act safely within the brachytherapy environment.
2. Perform routine quality assurance and safety tests on brachytherapy afterloading devices.
3. Create a dose distribution using a standard system for each of the intra-cavity and interstitial techniques, including image guided techniques.
4. Perform an independent verification of treatment plans, including the dose distribution.
5. Provide advice on brachytherapy treatment techniques.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Follow the progress of the patient from referral to the end of treatment and reflect on your learning from this process.

It is also recommended that trainees undertake the following clinical experiential learning:

- Produce a case-based study of a complex planning technique used in the local department – to include evaluation of the technique in terms of its applicability, effectiveness and benefits to patient treatment.
- Evaluate the local arrangements for source security and safety management.
- Discuss the importance, application and relevance of routine quality assurance to patient care and treatment.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1,2,5                 | Determine appropriate use of brachytherapy. | • Role of brachytherapy in the patient pathway, recognising its advantages and disadvantages for patient treatment.  
• Administration of Radioactive Substances Advisory Committee licence requirements.  
• Radiobiology applied to brachytherapy. |
| 1,2                   | Perform quality assurance (QA) on the treatment equipment, including source calibration, source strength checks, source positioning, dosimetry and interlock tests, including after a source exchange. | • Recommended practice (professional body and other guidance).  
• Dosimetry chain (reference code of practice).  
• National recommendations from professional bodies and guidance notes for relevant legislation.  
• Local implementation of quality control (QC) schedules within the departmental quality process and associated documentation.  
• Origin of the parameters that are checked (i.e. the connection to commissioning).  
• Manufacturer’s acceptance procedures and departmental processes, i.e. based on risk assessment regarding the equipment use.  
• The impact on the patient of unsafe practice. |
| 1                     | Handle radioactive sources safely under supervision. | • Contingency plans.  
• Radiation protection.  
• Local rules and procedures with regard to all relevant radiation protection legislation applied to brachytherapy, i.e. prior risk assessment and critical examination.  
• High Activity Sealed Source regulations and their use in the department.  
• Local security plans. |
| 1                     | Calculate radiation dose to the worker from a source (including the use of suitable protection). | • Concept of effective dose.  
• Relevant International Commission on Radiological Protection (ICRP) reports. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Treatment planning for a variety of treatments sites using standard template methods and image-guided methodologies.</td>
<td>• Incident reporting mechanism. • Brachytherapy treatment planning, including treatment effectiveness. • Understand the size and clinical relevance of uncertainties. • Standard system rules. • Image-guided techniques in brachytherapy planning. • Benefits of using other algorithms (cf. TG43). • Planning algorithms.</td>
</tr>
<tr>
<td>3,5</td>
<td>Evaluate brachytherapy plans for a range of clinical sites and different methodologies.</td>
<td>• Relevant guidelines (e.g. GEC-ESTRO/RCR guidelines). • Low Dose Rate (LDR), pulsed dose rate (PDR), High Dose Rate (HDR) and iridium wire techniques. • The patient experience of brachytherapy treatment.</td>
</tr>
<tr>
<td>4</td>
<td>Perform an independent dose calculation and treatment calculation.</td>
<td>• Meaning and need for independent checks, knowing the limitations of different treatment algorithms. • Local procedures.</td>
</tr>
<tr>
<td>2</td>
<td>Perform QA on the treatment-planning and associated imaging systems.</td>
<td>• Professional body recommendations. • Operation and limitations of imaging systems in use. • The effect of lack of QA on equipment effectiveness and patient treatment.</td>
</tr>
</tbody>
</table>
### MODULE 4
**Computing Related to Radiotherapy (RP4)**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
</table>

| AIM | To provide the trainee with development and experience relating to a range of computer-based applications within radiotherapy. |
| SCOPE | On completion of this module the trainee will be able to use a range of hardware configurations, operating systems and software applications for planning, treatment management and delivery of radiotherapy treatments for patients. |

### LEARNING OUTCOMES

On successful completion of this module the trainee will achieve the following work-based learning outcomes:

1. Use a variety of hardware configurations, operating systems and typical software applications.
2. Use contemporary planning, treatment management, delivery and dosimetry systems used in radiotherapy.
3. Participate in the specification, commissioning, validation, implementation and safe operation of contemporary radiotherapy equipment and software.
4. Participate in the safe execution of software upgrades or configuration changes within radiotherapy.
5. Use appropriate software for radiotherapy data processing.
6. Understand the governance, regulatory and data exchange standards that influence the procurement, maintenance and replacement of radiotherapy computer systems, including the anonymisation of patient data for clinical trials.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Review software or hardware upgrade processes or introduction of new information communication technologies (ICT) procedures – to include evaluation of the technique in terms of its applicability, effectiveness and benefits to patient treatment.
- Produce an example diagram of network configuration in radiotherapy. Present and discuss its use and application in terms of improvements in the context of patient treatment.
- Participate in the upgrade or commissioning of ICT systems in radiotherapy.
- Undertake routine quality assurance of ICT systems in radiotherapy.

All of these experiences should be recorded in your e-portfolio.

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Undertake a risk assessment on the computer systems related to radiotherapy</td>
<td>• Information governance.</td>
</tr>
<tr>
<td></td>
<td>and the associated network infrastructure.</td>
<td>• Virus protection in the context of mission critical equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Procedures for software control on mission critical medical devices.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Procedures for bespoke software control.</td>
</tr>
<tr>
<td>4,6</td>
<td>Identify relevant legislation, data protection and ICT security standards</td>
<td>• Information governance.</td>
</tr>
<tr>
<td></td>
<td>for collection, storage and transmission, and relate to the systems used.</td>
<td>• Data Protection Act and its importance for patient data.</td>
</tr>
<tr>
<td>1,2,3</td>
<td>Evaluate connectivity of all systems in use in radiotherapy.</td>
<td>• Digital Imaging and Communications in Medicine (DICOM) standard and its application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Basic networking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Firewalls, hardware specifications for clinical software, virtualisation, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local procedures and contingency plans.</td>
</tr>
<tr>
<td>1,3,4</td>
<td>Review and/or produce a project plan for a system upgrade, including risk</td>
<td>• Project management.</td>
</tr>
<tr>
<td></td>
<td>assessment and subsequent checks.</td>
<td>• Interactions of systems in use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Risks associated with system software upgrades relevant to patient safety.</td>
</tr>
<tr>
<td>3,4</td>
<td>Assist with the commissioning/verification of treatment-planning software,</td>
<td>• Commissioning data requirements of the chosen planning system and absolute reference</td>
</tr>
<tr>
<td></td>
<td>participating in the associated risk assessment.</td>
<td>measurements required for clinical release.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Changes/upgrades to planning software and associated quality assurance (QA).</td>
</tr>
<tr>
<td>3,4</td>
<td>Perform routine treatment-planning software systems QA, critically</td>
<td>• Professional body recommendations.</td>
</tr>
<tr>
<td></td>
<td>evaluating the results and reporting issues found.</td>
<td></td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1,3,5</td>
<td>Review arrangements for data warehousing for archiving and storage, and relevant legislation regarding the required retention time for information (including picture archiving and communication system, <em>Picture Archiving and Communications System</em> (PACS)).</td>
<td>• Information governance, PACS and relevant legislation.</td>
</tr>
</tbody>
</table>
| 6                     | Anonymise a range of patient data to meet the requirements of clinical trials. | • Information governance.  
• Data Protection Act and its importance for patient data. |
SECTION 10: CONTRIBUTORS
Contributor List

Members of the STP Work Based Learning Guide Development Group for Physical Sciences and Biomedical Engineering: Medical Physics

Production of the STP work based learning guides for Medical Physics has been coordinated by the Modernising Scientific Careers team and the National School of Healthcare Science working with NHS colleagues. The professionals who have contributed to the development of this Learning Guide include:

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<th>Name</th>
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<tbody>
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<td>Portsmouth Hospitals NHS Trust</td>
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<tr>
<td>Ian</td>
<td>Guy's and St Thomas' NHS Trust</td>
</tr>
<tr>
<td>Andy</td>
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</tr>
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<tr>
<td>Tony</td>
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</tbody>
</table>
Professional bodies and societies were invited to review the Learning Guides for Medical Physics and Clinical Engineering and their feedback has shaped the final publication:

IPEM  Institute of physics and Engineering in Medicine
BMUS  British Medical Ultrasound Society
BNMS  British Nuclear Medicine Society
IHEE  Institute of Healthcare Engineering & Estate Management
RESMG Rehabilitation Engineering Services Management Group

Modernising Scientific Careers Professional Advisor
Dr Derek Pearson

National School of Healthcare Science Professional Lead
Dr Chris Gibson

September 2012
SECTION 11: APPENDICES
# APPENDIX 1: GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Experiential Learning</td>
<td>The cyclical process linking concrete experience with abstract conceptualisation through reflection and planning.</td>
</tr>
<tr>
<td>Clinical Experiential Learning Outcomes</td>
<td>The activities that the trainee will undertake to enable and facilitate their learning in the workplace.</td>
</tr>
<tr>
<td>Competence</td>
<td>The ability of an individual to perform a role consistently to required standards combining knowledge, understanding, skills and behaviour.</td>
</tr>
<tr>
<td>Competence statements</td>
<td>Active and outcome-based statements that provide a further breakdown of the Learning Outcomes—reflecting what the trainee will be able to do in the workplace at the end of the programme. Each competence should linked back to the numbered Learning Outcomes.</td>
</tr>
<tr>
<td>Component</td>
<td>An indication of the type of module within a learning guide ie; rotational, specialist or elective.</td>
</tr>
<tr>
<td>Curricula</td>
<td>An outline of the expected educational outcomes across a subject area. The learning that is expected to take place during the Scientist Training Programme described in terms of knowledge, skills and attitudes,</td>
</tr>
<tr>
<td>Division</td>
<td>A high level description of an area of practice within healthcare science. There are three divisions: Life Sciences, Physical Sciences and Biomedical Engineering and Physiological Sciences.</td>
</tr>
<tr>
<td>Domains of Learning</td>
<td>Cognitive (knowledge and intellectual skills), affective (feelings and attitudes), interpersonal (behaviour and relationships with others) and psychomotor (physical skills)</td>
</tr>
<tr>
<td>Feedback</td>
<td>Specific information about the comparison between a trainee’s observed performance and a standard, given with the intent to improve the trainee’s performance. (van de Ridder JMM, Stokking KM, McGaghie WCand ten Cate OT. What is feedback in clinical education? Medical Education 2008: 42: 189–19)</td>
</tr>
<tr>
<td>Good Scientific Practice</td>
<td>Non-statutory guidance on the minimum requirements for good practice for the healthcare science workforce.</td>
</tr>
<tr>
<td>Host Department</td>
<td>The department which is responsible for the 3-year training programme and which the training officer is based.</td>
</tr>
<tr>
<td>Job</td>
<td>A specific definition of the work activities, requirements, skills required to undertake work activities within a local context. This differs from a role – see below.</td>
</tr>
<tr>
<td>Key Learning Outcome</td>
<td>A defined learning outcome linked to relevant competence(s) within the workplace Learning Guide</td>
</tr>
<tr>
<td>Knowledge and Understanding</td>
<td>The knowledge and understanding that must be applied in the workplace to achieve the stated competence.</td>
</tr>
<tr>
<td>Learning Framework</td>
<td>The specification for work based learning contained within the Learning Guide</td>
</tr>
<tr>
<td>Learning Module</td>
<td>A distinct set of learning outcomes and competences that form part of a programme. Modules may be rotational, specialist,</td>
</tr>
<tr>
<td><strong>Learning Outcome</strong></td>
<td>A high level, outcome based statement that describes what a trainee will be able to do at the end of the module.</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Mentoring</strong></td>
<td>Mentoring is a process in which a trainer (mentor) is responsible for overseeing the career and development of the trainee. The emphasis is therefore on the relationship (rather than the activity).</td>
</tr>
<tr>
<td><strong>Module Aim</strong></td>
<td>The overall objective of a work based learning module – defining the intended learning achievements of the trainee. The Aim works together with the ‘Scope’ statement to define the overall objectives and scope of the module</td>
</tr>
<tr>
<td><strong>Module Scope</strong></td>
<td>A statement within work based learning modules that defines the range/limits/ of the learning undertaken by the trainee in a module – patients/investigations/equipment/modalities etc)</td>
</tr>
<tr>
<td><strong>National Occupational Standards</strong></td>
<td>Nationally recognised standards of expected workplace performance and level of competence for a role. The standards are outcome-based, defining what the role holder should to be able to do, as well as what they must know and understand to demonstrate competent work performance. National Occupational Standards are supported by nationally agreed frameworks of expected attitudes, behaviour and skills.</td>
</tr>
<tr>
<td><strong>Practical Skill</strong></td>
<td>A cognitive, psychomotor, physical or communicative ability that supports performance of required role.</td>
</tr>
<tr>
<td><strong>Programme</strong></td>
<td>The package of learning, teaching assessment and quality assurance leading to an award.</td>
</tr>
<tr>
<td><strong>Provider</strong></td>
<td>An organisation that delivers required training and learning activities, to specified quality assurance requirements</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>A collection of functions undertaken in the workplace that represent the main broad areas of work for all similar workers at national level. A role differs from a job, the latter being defined specifically for a local context.</td>
</tr>
<tr>
<td><strong>Specialism</strong></td>
<td>A focused area of practice within a theme of healthcare science.</td>
</tr>
<tr>
<td><strong>Trainer</strong></td>
<td>A qualified individual who provides learning and development support for trainees</td>
</tr>
<tr>
<td><strong>Theme</strong></td>
<td>A cluster of related specialisms within a division of healthcare science.</td>
</tr>
<tr>
<td><strong>Work based learning</strong></td>
<td>Learning that takes place in a real work setting and involves the application of academic learning to real work activities</td>
</tr>
<tr>
<td><strong>Work Performance</strong></td>
<td>The requirements of satisfactory and consistent demonstration of competence in specified functions for a work role.</td>
</tr>
<tr>
<td><strong>Work place</strong></td>
<td>A real work setting in which the trainee can apply learning.</td>
</tr>
</tbody>
</table>
APPENDIX 2: GOOD SCIENTIFIC PRACTICE

Good Scientific Practice

Section 1: The purpose of this document

There are three key components to the Healthcare Science workforce in the UK:

1. Healthcare Science Associates and Assistants who perform a diverse range of task based roles with appropriate levels of supervision.

2. Healthcare Science Practitioners have a defined role in delivering and reporting quality assured investigations and interventions for patients, on samples or on equipment in a healthcare science specialty, for example Cardiac Physiology, Blood Sciences or Nuclear Medicine. They also provide direct patient care and more senior Healthcare Science Practitioners develop roles in specialist practice and management.

3. Healthcare Scientists are staff that have clinical and specialist expertise in a specific clinical discipline, underpinned by broader knowledge and experience within a healthcare science theme. Healthcare scientists undertake complex scientific and clinical roles, defining and choosing investigative and clinical options, and making key judgements about complex facts and clinical situations. Many work directly with patients. They are involved, often in lead roles, in innovation and improvement, research and development and education and training. Some pursue explicit joint academic career pathways, which combined clinical practice and academic activity in research, innovation and education.

This document sets out the principles and values on which good practice undertaken by the Healthcare Science workforce is founded.

Good Scientific Practice sets out for the profession and the public the standards of behaviour and practice that must be achieved and maintained in the delivery of work activities, the provision of care and personal conduct.

Good Scientific Practice uses as a benchmark the Health Professions Council (HPC) Standards of Proficiency and Standards of Conduct, Performance and Ethics, but expresses these within the context of the specialities within Healthcare Science, recognising that three groups of the workforce, Biomedical Scientists, Clinical Scientists and Hearing Aid Dispensers are regulated by the HPC. The aim is that the standards are accessible to the profession and understandable by the public.
Good Scientific Practice represents standards and values that apply throughout an individual’s career in healthcare science at any level of practice. The standards will be contextualised by the role within Healthcare Science that an individual undertakes. This means that the standards must be interpreted based on the role that an individual performs. For example, in supervised roles where individuals work within defined procedures, rather than autonomously, some standards will need to be interpreted appropriately for the context of the specific role. There will, however, always be a requirement for an individual to work within the limits of their scope of practice and competence.

Students and trainees will be expected to be working towards meeting the expectations set out in this document. However, if an individual is undertaking further training and development following qualification from a professional training programme, he or she will be expected to be able to meet the standards in this document within their scope of practice.

The standards have been used to support curriculum development and will be used to underpin the process of judging individual equivalence, particularly for emerging specialisms.

The standards have been divided into five domains. The domains of Good Scientific Practice detailed in section 2 are:

1. Professional Practice
2. Scientific Practice
3. Clinical Practice
4. Research and development
5. Clinical Leadership

Section 2: The domains of Good Scientific Practice

Domain 1: Professional Practice

All patients and service users are entitled to good standards of professional practice and probity from the Healthcare Science workforce including the observance of professional codes of conduct and ethics. In maintaining your fitness to practice as a part of the Healthcare Science workforce, you must:

1.1 Professional Practice

1.1.1 Make the patient your first concern
1.1.2 Exercise your professional duty of care
1.1.3 Work within the agreed scope of practice for lawful, safe and effective healthcare science
1.1.4 Keep your professional, scientific, technical knowledge and skills up to date
1.1.5 Engage fully in evidence based practice
1.1.6 Draw on appropriate skills and knowledge in order to make professional judgements
1.1.7 Work within the limits of your personal competence
1.1.8 Act without delay on concerns raised by patients or carers or if you have good reason to believe that you or a colleague may be putting people at risk

1.1.9 Never discriminate unfairly against patients, carers or colleagues

1.1.10 Treat each patient as an individual, respect their dignity and confidentiality and uphold the rights, values and autonomy of every service user, including their role in the diagnostic and therapeutic process and in maintaining health and well-being.

1.1.11 Respond constructively to the outcome of audit, appraisals and performance reviews, undertaking further training where necessary

1.2 Probity

1.2.1 Make sure that your conduct at all times justifies the trust of patients, carers and colleagues and maintains the public’s trust in the scientific profession

1.2.2 Inform the appropriate regulatory body without delay if, at any time, you have accepted a caution, been charged with or found guilty of a criminal offence, or if any finding has been made against you as a result of fitness to practice procedures, or if you are suspended from a scientific post, or if you have any restrictions placed on your scientific, clinical or technical practice

1.2.3 Be open, honest and act with integrity at all times, including but not limited to: writing reports, signing documents, providing information about your qualifications, experience, and position in the scientific community, and providing written and verbal information to any formal enquiry or litigation, including that relating to the limits of your scientific knowledge and experience

1.2.4 Take all reasonable steps to verify information in reports and documents, including research

1.2.5 Work within the Standards of Conduct, Performance and Ethics set by your profession

1.3 Working with colleagues

1.3.1 Work with other professionals, support staff, service users, carers and relatives in the ways that best serve patients’ interests

1.3.2 Work effectively as a member of a multi-disciplinary team

1.3.3 Consult and take advice from colleagues where appropriate

1.3.4 Be readily accessible when you are on duty

1.3.5 Respect the skills and contributions of your colleagues

1.3.6 Participate in regular reviews of team performance.

1.4 Training and developing others

1.4.1 Contribute to the education and training of colleagues

1.4.2 If you have responsibilities for teaching, develop the skills, attitudes and practices of a competent teacher

1.4.3 Ensure that junior colleagues and students are properly supervised

1.4.4 Support colleagues who have difficulties with performance, conduct or health
1.4.5 Share information with colleagues to protect patient safety
1.4.6 Provide work-based development for colleagues to enhance/improve skills and knowledge

Domain 2: Scientific Practice

As a part of the Healthcare Science workforce, you will keep your scientific and technical knowledge and skills up to date to effectively:

2.1 Scientific Practice

2.1.1 Develop investigative strategies/procedures/processes that take account of relevant clinical and other sources of information
2.1.2 Provide scientific advice to ensure the safe and effective delivery of services
2.1.3 Undertake scientific investigations using qualitative and quantitative methods to aid the screening, diagnosis, prognosis, monitoring and/or treatment of health and disorders appropriate to the discipline
2.1.4 Investigate and monitor disease processes and normal states
2.1.5 Provide clear reports using appropriate methods of analysing, summarising and displaying information
2.1.6 Critically evaluate data, draw conclusions from it, formulate actions and recommend further investigations where appropriate

2.2 Technical Practice

2.2.1 Provide technical advice to ensure the safe and effective delivery of services
2.2.2 Plan, take part in and act on the outcome of regular and systematic audit
2.2.3 Work within the principles and practice of instruments, equipment and methodology used in the relevant scope of practice
2.2.4 Demonstrate practical skills in the essentials of measurement, data generation and analysis
2.2.5 Assess and evaluate new technologies prior to their routine use
2.2.6 Identify and manage sources of risk in the workplace, including specimens, raw materials, clinical and special waste, equipment, radiation and electricity.
2.2.7 Apply principles of good practice in health and safety to all aspects of the workplace
2.2.8 Apply correct methods of disinfection, sterilisation and decontamination and deal with waste and spillages correctly.
2.2.9 Demonstrate appropriate level of skill in the use of information and communications technology

2.3 Quality

2.3.1 Set, maintain and apply quality standards, control and assurance techniques for interventions across all clinical, scientific and technological activities
2.3.2 Make judgements on the effectiveness of processes and procedures
2.3.3 Participate in quality assurance programmes
2.3.4 Maintain an effective audit trail and work towards continuous improvement

**Domain 3: Clinical Practice**

As a part of the Healthcare Science workforce, you will keep your clinical skills up to date and undertake the clinical duties appropriate to your role in order to effectively:

**3.1 Clinical Practice**

3.1.1 Ensure that you and the staff you supervise understand the need for and obtain relevant consent before undertaking any investigation, examination, provision of treatment, or involvement of patients and carers in teaching or research
3.1.2 Ensure that you and the staff you supervise maintain confidentiality of patient information and records in line with published guidance
3.1.3 Ensure that you and your staff understand the wider clinical consequences of decisions made on your actions or advice
3.1.4 Demonstrate expertise in the wider clinical situation that applies to patients who present in your discipline
3.1.5 Maintain up to date knowledge of the clinical evidence base that underpins the services that you provide and/or supervise and ensure that these services are in line with the best clinical evidence
3.1.6 Plan and determine the range of clinical/scientific investigations or products required to meet diagnostic, therapeutic, rehabilitative or treatment needs of patients, taking account of the complete clinical picture
3.1.7 Plan and agree investigative strategies and clinical protocols for the optimal diagnosis, monitoring and therapy of patients with a range of disorders
3.1.8 Ensure that detailed clinical assessments are undertaken and recorded using appropriate techniques and equipment and that the outcomes of these investigations are reviewed regularly with users of the service
3.1.9 Ensure the provision of expert interpretation of complex and or specialist data across your discipline in the context of clinical questions posed
3.1.10 Undertake and record a detailed clinical assessment using appropriate techniques and equipment
3.1.11 Provide specialised clinical investigation and/or analysis appropriate to your discipline
3.1.12 Provide interpretation of complex and/or specialist data in the context of the clinical question posed
3.1.13 Provide clinical advice based on results obtained, including a diagnostic or therapeutic opinion for further action to be taken by the individual directly responsible for the care of the patient
3.1.14 Provide expert clinical advice to stakeholders in order to optimise the efficiency and effectiveness of clinical investigation of individuals and groups of patients
3.1.15 Prioritise the delivery of investigations, services or treatment based on clinical need of patients
3.1.16 Represent your discipline in multidisciplinary clinical meetings to discuss patient outcomes and the appropriateness of services provided
3.1.17 Ensure that regular and systematic clinical audit is undertaken and be responsible for modifying services based on audit findings.

3.2 Investigation and reporting

3.2.1 Plan and conduct scientific, technical, diagnostic, monitoring, treatment and therapeutic procedures with professional skill and ensuring the safety of patients, the public and staff
3.2.2 Perform investigations and procedures/design products to assist with the management, diagnosis, treatment, rehabilitation or planning in relation to the range of patient conditions/equipment within a specialist scope of practice
3.2.3 Monitor and report on progress of patient conditions/use of technology and the need for further interventions.
3.2.4 Interpret and report on a range of investigations or procedures associated with the management of patient conditions/equipment

Domain 4: Research, Development and Innovation

As part of the Healthcare Science workforce, research, development and innovation are key to your role. It is essential in helping the NHS address the challenges of the ageing population, chronic disease, health inequalities and rising public expectations of the NHS. In your role, you will undertake the research, development and innovation appropriate to your role in order to effectively:

4.1 Research, Development and Innovation

4.1.1 Search and critically appraise scientific literature and other sources of information
4.1.2 Engage in evidence-based practice, participate in audit procedures and critically search for, appraise and identify innovative approaches to practice and delivery of healthcare
4.1.3 Apply a range of research methodologies and initiate and participate in collaborative research
4.1.4 Manage research and development within a governance framework
4.1.5 Develop, evaluate, validate and verify new scientific, technical, diagnostic, monitoring, treatment and therapeutic procedures and, where indicated by the evidence, adapt and embed them in routine practice
4.1.6 Evaluate research and other available evidence to inform own practice in order to ensure that it remains at the leading edge of innovation.
4.1.7 Interpret data in the prevailing clinical context
4.1.8 Perform experimental work, produce and present results
4.1.9 Present data, research findings and innovative approaches to practice to peers in appropriate forms
4.1.10 Support the wider healthcare team in the spread and adoption of innovative technologies and practice
Domain 5: Clinical Leadership

All patients and service users have a right to expect that Healthcare Science services efficiently and effectively managed to meet service needs. As a leader in Healthcare Science, you will seek to effectively:

5.1 Leadership

5.1.1 Maintain responsibility when delegating healthcare activities and provide support as needed
5.1.2 Respect the skills and contributions of your colleagues
5.1.3 Protect patients from risk or harm presented by another person’s conduct, performance or health
5.1.4 Treat your colleagues fairly and with respect
5.1.5 Make suitable arrangements to ensure that roles and responsibilities are covered when you are absent, including handover at sufficient level of detail to competent colleagues
5.1.6 Ensure that patients, carers and colleagues understand the role and responsibilities of each member of the team
5.1.7 Ensure that systems are in place through which colleagues can raise concerns and take steps to act on those concerns if justified
5.1.8 Ensure regular reviews of team performance and take steps to develop and strengthen the team
5.1.9 Take steps to remedy any deficiencies in team performance
5.1.10 Refer patients to appropriate health professionals
5.1.11 Identify and take appropriate action to meet the development needs of those for whom you have management, supervision or training responsibilities
5.1.12 Act as an ambassador for the Healthcare Science community

Good Scientific Practice AHCS V.2 Final
APPENDIX 3: FURTHER INFORMATION

NHS Networks

An open network to share curricula produced for the Modernising Scientific Careers programme. Join this network to get updates whenever there is new content.

Details of the Scientist Training Programme including MSc Clinical Science Curricula, Work Based Learning Guides.

Chief Scientific Officer (CSO), Department of Health

Source of information and news including the CSO Bulletin, latest press releases, publications and consultations.
http://www.dh.gov.uk/health/category/chief-scientific-officer/

National School of Healthcare Science (NSHCS)

The National School of Healthcare Science is an important part of the new system for healthcare science training established through Modernising Scientific Careers. This new system was set up to ensure that patients benefit from the scientific and technical advances by ensuring that healthcare science staff have the knowledge and skills to put these advances into practice.
www.nshcs.org.uk

Academy for Healthcare Science (AHCS)

The Academy for Healthcare Science (AHCS) is a UK wide organisation bringing together a diverse and specialised scientific community working within the National Health Service (NHS) and other associated organisations (e.g. the Health Protection Agency, NHS Blood and Transplant), Health and Social Care Northern Ireland (HSCNI) and the academic and independent healthcare sector.
http://www.academyforhealthcarescience.co.uk/

Health and Care Professions Council (HCPC)

The HPC are a regulator set up to protect the public. They keep a register of health professionals who meet the HPC standards for their training, professional skills, behaviour and health.
http://www.hpc-uk.org/

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