DEVELOPING WORLD-CLASS PERFORMANCE IN HEALTHCARE SCIENCE

A LEARNING GUIDE

FOR

HEALTHCARE SCIENTISTS

Theme	Clinical Engineering
Pathway	Rehabilitation Engineering

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Appendices

- Good Scientific Practice
- Scope of Practice for Healthcare Scientists
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SECTION 1

Introduction

1.1. Learning and development for Healthcare Scientists

The aim of this programme is to develop world class performance in healthcare science.

The Scientist Training Programme (STP) in Rehabilitation Engineering is designed to provide the Healthcare Scientist (HCS) with strong science-based, clinical training across all aspects of the specialism with an appropriate level of underpinning scientific knowledge to enable them to perform in a range of healthcare settings. The full curricula for can be found on this link www.networks.nhs.uk/nhs-networks/msc-framework-curricula This Learning Guide describes the Scientist work based training programme in Rehabilitation Engineering and should be read in conjunction with the *Operational Framework for Modernising Scientific Careers (MSC) (planned for publication in December 2011), the University Handbook from Relevant academic institution (MSc in Clinical Sciences Engineering Rehabilitation Engineering)* and the manual for the *Online Assessment and Personal Management System.*. The training will be delivered both in the work place and in the University and the trainee will also be part of the National School of Healthcare Science in for the duration of their training. The National School will oversee the trainee performance using the online assessment function and will actively follow progression of all trainees throughout the programme. The National School will also work with the Strategic Health Authority Modernising Scientific Careers leads to ensure the smooth delivery of the programme.

At the end of the programme the successful Trainee will receive an MSc in Clinical Engineering Science – Rehabilitation Engineering and a Certificate of Competence for the work based programme.

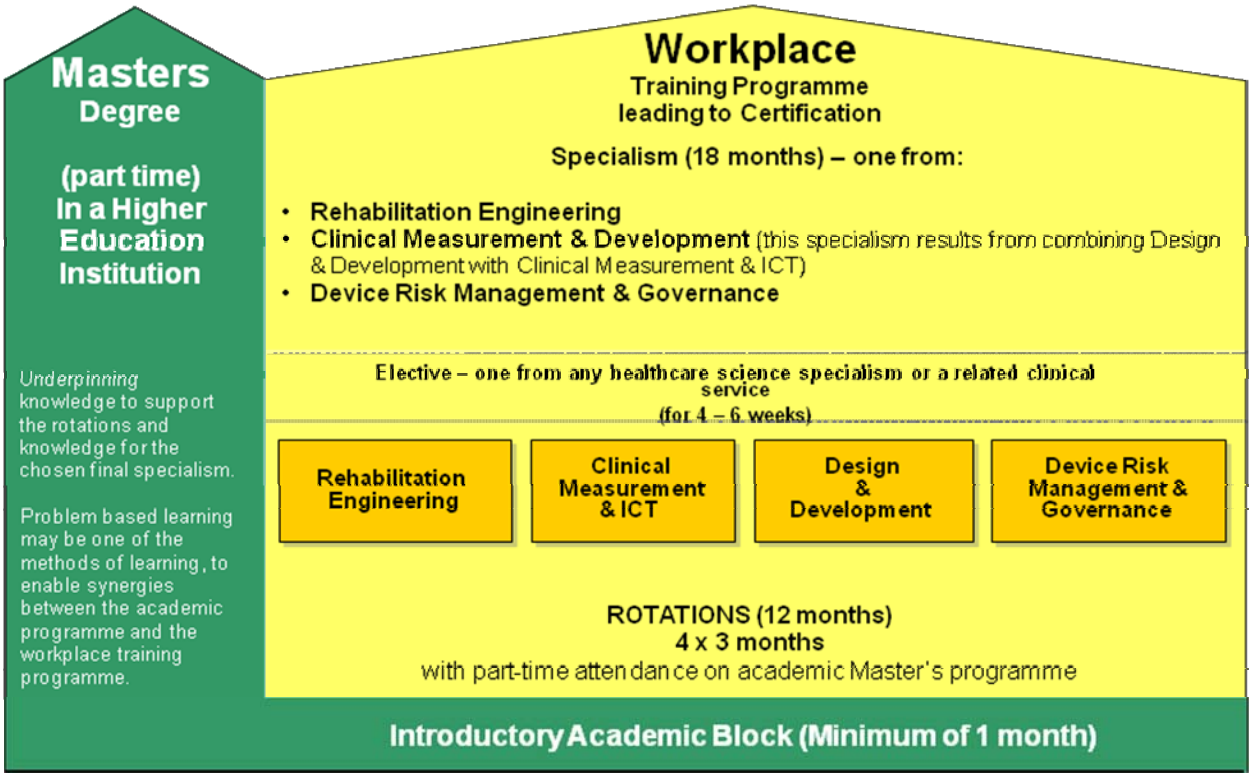
Description of Healthcare Science themed pathways

The Healthcare Science workforce consists of a diversity of specialisms. All involve the application of science, technology, engineering or mathematics to health. Traditionally, these specialisms have been divided into three broad divisional areas: life sciences, physical science and engineering and physiological science. However rapid advances in science and technology and changes in patient needs and service delivery are beginning to blur the lines between these divisions. In recognition of these changes, grouping the more than 45 specialisms into 7 themed pathways is proving to be a helpful way forward:

- Infection sciences
- Blood Sciences – where Clinical Biochemistry sits
- Cellular Science
- Neurosensory sciences
- Cardiovascular, Respiratory and Sleep Sciences
- Clinical Engineering
- Medical Physics

For Rehabilitation Engineering Science the indicative content of the 3 years is shown below. The rotational periods consist of the 4 disciplines from the Clinical Engineering theme. The order, and to some extent, the duration of the rotations may vary according to local availability. Clinical Measurement and ICT are common to the 3 disciplines.

Rehabilitation Engineering



Broadly, the scheme of the STP includes work based training in 4 specialist clinical engineering disciplines over the first period of training, with Clinical Measurement being common to Clinical Engineering.

Each period of training will last for approximately 3 months depending on local arrangements and taking into account any periods of Annual leave.

At some point during the specialist training period there will be a 4-6 week elective period arranged by your local department but this may not always follow directly on from the initial rotational period. The aim of the elective period is to allow the trainees to experience other clinical departments, possibly in a different theme that has relevance to Rehabilitation Engineering.

The remaining time will be spent on specialist Rehabilitation Engineering training.

This work based component complements and utilises the parallel academic programme of training which results in a Masters degree in Clinical Engineering Science – Rehabilitation Engineering.

A generic module "Professional Practice" is included in the work based training element of the STP for all specialisms**;** this covers associated behaviours and Professional Practice common to all of Healthcare Science.

The Scope of Practice of a Healthcare Scientist (HCS)

Healthcare Scientists in Rehabilitation Engineering will have clinical and specialist expertise underpinned by theoretical knowledge and experience in the specialism, and by broader knowledge and experience within the healthcare themes. They will undertake complex scientific and clinical roles, defining and choosing investigative and clinical options, making key judgements about complex facts and clinical situations for patients who require expert Clinical Engineering advice. They will work directly with medical colleagues, within the multidisciplinary team, to consult and advise patients. They will be involved, often in lead roles, in innovation and improvement, Rehabilitation Engineering research and development and education and training. Some will pursue explicit academic career pathways which combine clinical practice and activity in research, innovation and education.

Good Scientific Practice

Good Scientific Practice [GSP] sets out the principles and values on which good practice within Healthcare Science Rehabilitation Engineering is founded. It makes explicit, for Healthcare Scientists, the public and healthcare providers, the standards of behaviour and practice that must be achieved and maintained in the delivery of work activities and clinical care. *GSP* is designed to contextualise the standards of practice and proficiency set down by the Health Professions Council (HPC) in a way that is accessible to the profession and the public. It therefore uses as its basis the HPC Standards of Proficiency and HPC Standards of Conduct, Performance and Ethics, which have been further elaborated for Healthcare Scientists in Good Scientific Practice, details of which can be found in the Appendices to this Guide.

1.2 How to use this learning guide

Providers of work based-learning

Section 2 provides an initial reference tool to assist providers with the provision of the training programme. Use of this reference tool will facilitate planning for the delivery of the programme, including the management of the required rotational experience within, or external to the main provider.

Following review of this reference tool, providers should ensure that they obtain and are fully familiar with details in several specialist areas of training, e.g.

- requirements for training work based trainers
- assessment processes
- quality assurance and monitoring requirements
- the providers' role in supporting *equivalence* programmes for individual trainees

This information will be available in the *Operational Framework for Education and Training in Healthcare Science,* due to be published in December 2011.

Section 3 contains an overview of the Rehabilitation Engineering programme and its delivery.

. **Section 4** contains detail on the work based learning outcomes, suggested clinical experience, competences, knowledge base and outcome performance measures (assessment criteria) and associated behaviours for each module associated with the Rehabilitation Engineering programme .

Appendices provide further reference materials related to development and assessment in skills, behaviours and expectations of Healthcare Scientists.

Healthcare Science Trainees

Section 3 contains an overview of the Rehabilitation Engineering programme and its delivery.

Section 4 is the Learning Framework which provides the training details of the programme. This is presented in a modular format and represents, as measures of successful completion of the programme and its learning outcomes the;

- clinical experience/assessment criteria for development of competence with recommended assessment tools/methods/criteria
- competences associated with successful work performance
- associated knowledge the trainee will be able to apply
- skills and behaviours associated with effective performance

Appendices provide further reference materials related to development and assessment in skills, behaviours and expectations of Healthcare Scientists.

Other reference materials are available through the Learning and Development Manager at the providing institution/location e.g. assessment of training details, equivalence (of prior learning and experience) processes, and monitoring and quality assurance of training programmes.

SECTION 2

Guidance for providers of work based learning in Rehabilitation Engineering

2.1 Programme structure and rotations

PROGRAMME STRUCTURE

The workplace-based element of the Healthcare Scientist Training Programme (STP) in Rehabilitation Engineering takes place over the three years of the Programme. It commences with rotations taken from those shown in the Clinical Engineering Theme diagram; one of these rotational placements will be in Clinical Measurement and will form the introduction to the specialist modules in Rehabilitation Engineering. Clinical Measurement and ICT are common to the other 3 disciplines.

The timings of these modules will depend of local availability and will be organised locally in conjunction with your Strategic Health Authority Modernising Scientific Careers leads.

In the second phase of the work based training trainees specialise in Rehabilitation Engineering based in the host Trust.

The Scientist training programme also includes a specific research module which will be a combination of training in research methodology and a research project carried out in conjunction with the academic provider.

The Professional Practice element of the curriculum underpins both the academic and the workplace training and is based on *Good Scientific Practice* (see Appendices)

This Guide describes in detail for trainees and providers the workplace training for the 4 rotational placements and for the specialist programme in Rehabilitation Engineering, in particular the curriculum content of the work based training, the details of the assessment programme and the e- portfolio structure.

It is the role of the providers of work based training to take responsibility for organising their own delivery timetables, in conjunction with the academic providers.

It is important to recognise that in the delivery of these new training programmes trainees are essentially supernumerary to service provision and will need identified and protected time to undertake their academic studies. However an equally important part of this programme is clinical competence, wherever possible and under

appropriate supervision trainees should be involved directly in clinical and department practice.

Each trainee should be assigned a trainer for the duration of the programme.

Throughout the early implementation of these new training programmes the National School of Healthcare Science will provide a national co-ordinating function to support departments in delivery. Assistance will be available in terms of organising specialist rotations that might need national coordination, successful implementation of the assessment tool and the provision of a train the trainer programme. The School will continue to function with a high level over sight of all the Rehabilitation Engineering trainees and co-ordinate mid term and final work based assessments .The School will also liaise with relevant academic institution to ensure the timely delivery of the academic programme.

2.2. Requirements for delivery

QUALITY OBJECTIVES AND MEASURES FOR PROVIDERS OF WORKPLACE-BASED TRAINING

All training departments are responsible for the delivery of the work based training quality standards detailed in the Learning and Development Agreement (LDA) issued by their local Strategic Health Authority, Modernising Scientific Careers Leads**.**

This section provides a reference tool for work based training providers to assist with decision-making to deliver the full content of this training programme. Providers may need to include plans for working with other approved providers in order to meet the rotation and elective components, although the host provider continues to hold the responsibility for the overall quality of training provision for trainees, by regular contact e.g., weekly catch up sessions.

The table below draws providers' attention to some of the challenging issues that must be addressed in the Rehabilitation Engineering training programme.

RESOURCE OBJECTIVES

Quality objective	Requirements
Staff resources The delivery and assessment of the Rehabilitation Engineering Healthcare Science programme requires an appropriate programme faculty across each component of the programme, all of whom have undertaken appropriate training for the role	• Trainers are appropriately trained and qualified in training and assessment • Trainers are vocationally competent to train and assess trainees in the learning outcomes of the curriculum. • Trainers are given sufficient time to effectively fulfil all aspects of the role and ensure the quality of the programme
Physical Resources The provider will ensure that sufficient physical resources are available, operational and approved for the required training	• There are sufficient physical resources to ensure that trainees can undertake the required rotations.
Rotations The range of clinical services to be available in each rotational site can be found by reference to the rotational modules in section 4	• This may require arrangements with other providing institutions – with responsibility for ensuring quality and consistency of provision remaining with the originating provider
Electives The provider will ensure that sufficient resources and locations are available for the elective component for 4-6 weeks	• Available resources for electives in any Healthcare Science specialism or related clinical service
Specialist Rehabilitation Engineering training The provider will ensure that sufficient physical resources are available for specialist training in Rehabilitation Engineering	• Available resources for single specialism training in Rehabilitation Engineering, including the research module

SECTION 3

Guidance for Healthcare Scientist trainees in Rehabilitation Engineering

3.1 The role of the Healthcare Scientist in Rehabilitation Engineering

Healthcare Scientists in Rehabilitation Engineering fulfil all elements of the generic Scope of Practice for the specialism. They must use knowledge and experience across a wide range of clinical pathways in Rehabilitation Engineering services. They will be involved in the assessment, design, fitting and evaluation of

- Aids for daily living
- Clinical gait analysis (CGA)
- Electronic assistive technology (EAT)
- Functional electrical stimulation (FES)
- Medical engineering design / instrumentation, mechanical and electronic (MED)
- Postural management
- Prosthetics and orthotics
- Wheelchairs

The following roles will be developed throughout the training programme by a combination of work based competencies, underpinning academic knowledge and clinical experience. They are not exhaustive, but are indicative of the multi-layered role of the Healthcare Scientist in Rehabilitation Engineering

Clinical Role

- Offer clinical advice on follow up and management
- Recognise the role and importance of the multidisciplinary team environment for optimum patient care.

Managerial Role

- Provide an appropriate, modern range of services in a patient focussed environment
- Understand the legal framework for testing including ethical, legal and social implications
- Conduct clinical audit

Research/Training and Education

- Participate in relevant collaborative research
- Contribute to evidence based good practice guidelines
- Research the application of scientific investigation to one or more clinical situations in Rehabilitation Engineering
- Lead or develop or participate in training and education of Healthcare Scientists in Rehabilitation Engineering

Professional Practice

Be a role model in excellent professional behaviours and practice as described by Good Scientific Practice

3.2 About the programme – what the trainee will do

Healthcare Scientists in Rehabilitation Engineering work within the multidisciplinary clinical team to perform a number of functions. The following pages provide a broad overview of the role and functions related to the specialist Rehabilitation Engineering and rotational components of the work based part of this programme.

The detailed performance measures are included in **Section 4** which serves as the basis for programme design, delivery and assessment

Induction

Each time a trainee begins workplace-based training in a new clinical or department environment, an induction will be provided and will include.

- Local hospital induction – local policies
- Review of local service and functioning of the department and any related operations
- Review of clinical users of the department service
- Review and more detailed description of health and safety, pertinent to the modules and to the local department.
- Basic knowledge about the function, operation of equipment appropriate to the section(s) of the department in which the trainee will be working

Rotational Programme

The aim of the rotational programme is to introduce the breadth of underpinning knowledge necessary to fulfil the role of a Healthcare Scientist in Rehabilitation Engineering.

Within the Rehabilitation Engineering Programme the following rotational placements operate. The following provides a broad outline of the aims of each rotation. Detailed learning outcomes, workplace competences and knowledge specification are included in the Learning Framework in section 4. The corresponding academic components of these modules are being delivered by relevant academic institution using a blended learning approach described in the Handbook for the MSc

Rotational Placements in Rehabilitation Engineering	Aim
Rehabilitation Engineering	To allow the trainee to experience a wide range of clinical services and subject areas both to allow them to work effectively in the clinical setting and to assist them in choosing their future area of specialisation • Aids for daily living • Clinical gait analysis (CGA) • Electronic assistive technology (EAT) • Postural management • Prosthetics and orthotics • Wheelchairs
Clinical Measurement and Development	To introduce the trainee to the development lifecycle from user specification through to validation and verification. The trainee will apply the methodology to a small project or component of a larger project in medical device design and development
Device Risk Management and Governance	Trainees will experience an overview of devise management, become familiar with a range of medical devises, selection and acceptance testing, maintenance and repair, patient safety and risk assessment and medical devises ICT systems

Aims of Specialist training in Rehabilitation Engineering

The Healthcare Scientist Programme in Rehabilitation Engineering provides workplace-based training to complement the academic learning programme provided through the MSc in Clinical Science (Rehabilitation Engineering).

Clinical Module	**Aim** .
Rehabilitation engineering	The trainee can undertake a physical and functional assessment of the patient and prescribe appropriate individual engineering solutions • Aids for daily living • Clinical gait analysis (CGA) • Electronic assistive technology (EAT) • Functional Electrical Stimulation • Postural management • Prosthetics and orthotics • Wheelchairs
Clinical gait analysis	The trainee can undertake, measurement of gait parameters in a clinical context and perform suitable and appropriate analyses on the data including presentation in appropriate visual and/or numerical format, followed by an assessment resulting in an interpretation of the data
Medical engineering design, instrumentation mechanical and electronic	The trainee can design and develop novel devices and bring new systems into service safely and effectively
Research project in Rehabilitation Engineering	The overall aim of this module, building on the Research Methods module is for the trainee to undertake research that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret new information in a specialism of healthcare science. During Years 2 and 3 the trainee will undertake a creative piece of research involving the application of scientific investigation to one or more clinical situations. The trainee will also be expected to complete either one [single] large research project or three shorter health services research projects to gain an understanding of

	the health services contexts within which clinical research is undertaken. Whichever is chosen they should include: • Evidence-based practice • Clinical audit • Supporting service users

Trainees will complete a research project in Rehabilitation Engineering to show originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret new information in Rehabilitation Engineering. The research project will be carried out in conjunction with the relevant academic institution.

The generic 'Professional Practice' module underpins training and performance across the whole programme.

3.4 About the Programme - how you will be assessed

Assessment

There will be continuous assessment during the workplace-based training using a series of validated workplace based assessment tools. Trainees will be expected to keep a record of all assessments and competences in their e-training portfolio.

The overall workplace based assessment programme comprises a number of assessment tools.

- *Case based discussion* (CbD)
    - This tool is designed to demonstrate the trainee's knowledge and understanding of any aspect of an 'output' for which they have been wholly or partially responsible. This can range from discussion of the science behind the 'output' to ethical and communication issues arising in context.
- *Direct observation of practical skills*
    - This tool records an observation of a skill or procedure. Feedback is given and learning needs identified. Each discipline will have a core list of skills with documentation of what is expected at the relevant stage of training
- *Multi-source feedback*
    - The tool enables feedback to be given to trainees by different colleagues who work with them. The trainee and trainer nominate a range of colleagues who will be invited in accordance with agreed guidelines for who is eligible.
    - Research has shown that 8-10 raters are necessary to achieve reliability.
    - The trainee also rates him/herself.
    - This tool is also entirely on-line and there is no local paperwork. A report is generated which should be discussed with the trainee by a trainer who has been trained in giving feedback. The report is placed in the online training portfolio.
- *Observation of clinical events* (based on Mini-Cex)
    - A clinical event is defined as any occasion when the trainee/student is present with a patient as part of the clinical team. This is true for all patient-facing occasions whether the trainee only observes, or speaks to, touches, positions or examines a patient.
    - The tool records aspects of the trainee's communication and clinical skills as relevant. It also records professionalism

The assessment programme is an integral part of the curriculum. The curriculum in turn is based on *Good Scientific Practice*. This linkage is crucial to standard setting and to support review of the satisfactory progression of trainees through the programme. The assessment tools taken together therefore provide evidence/information about the trainee's ability in relation to all aspects of the curriculum.

The evidence provided by the work place based assessments taken together provide evidence/ information about the trainee's ability, demonstrated in the workplace, in relation to all aspects of the curriculum.

Assessment Tool	**DOPS**	**MiniCex**	**CbD**	**MSF**
Purpose	**Observation** Observe and assess the conduct of a practical procedure	**Observation** Observe and assess a clinical encounter	**Conversation/ discussion** Discuss an outcome/ output from workplace activity using a record, result,	**Review by others/colleagues** Professionalism Interpersonal skills/Team working Communication
Takes place	**Process** Reviewed and documented with feedback in the moment/ as it is happening	**Process** Reviewed and documented with feedback in the moment/ as it is happening	**Outcome/output** Discussing, explaining, justifying aspects of the report/record/result. Including aspects of professionalism	**Reflecting** on comments of others within the framework of constructive feedback

There is a requirement for each trainee to engage with the assessment process and to complete a minimum numbers of the different types of assessments within each module; these will be detailed in the assessment manual and on the tool.

Online assessment and personal development management system

An online assessment and personal development management system provides an electronic medium for completion and logging of all of the personal assessments related to the workplace elements for the Modernising Scientific Careers (MSC) training programmes and is available for the work place elements of the programme.

The electronic portfolio provides support to the trainees with their continuous professional development throughout the training programme and provides a mechanism through which their development and progress can be monitored and managed.

Progression

Maintaining the electronic portfolio is an integral part of the workplace based programme and its maintenance by the trainees is essential for progression. Trainees are responsible for maintaining their portfolio and keeping keep a record of all assessments and competences and information relating to their progression through the programme up to date.

The National School of Healthcare Science will use the assessment tool to consider the trainee's progression at any time within the programme and to provide feedback around areas of development. The successful completion of the online assessments will form the main body of evidence for the School and the Professional bodies to award the Certificate of Competence.

Rotation Assessment

During the rotational periods there should be one DOP and one CBD completed for each rotation.

The clinical experiential learning should be recorded on the online tool as reflective learning and will form an important part of your portfolio.

The trainees must complete all competences by the end of the rotation.

SECTION 4

The Learning Framework

The following section provides the framework for the design, delivery and assessment of learning and performance outcomes and associated knowledge and skills.
The framework provides a specification for each rotation and then for the specialist component of the programme
All of the underpinning academic knowledge will be taught as part of the Masters programme delivered by the academic provider

Rotational Modules

CLINICAL ENGINEERING

CLINICAL MEASUREMENT AND DEVELOPMENT

Rotation Module

MODULE TITLE	Clinical Engineering Clinical measurement and development	**COMPONENT**	**Rotation**
AIM	To introduce the trainee to the development lifecycle from user specification through to validation and verification. The trainee will apply the methodology to a small project or component of a larger project in clinical measurement, ICT or medical device design and development		
SCOPE	On completion of this module the trainee will be able to translate a user concept into a full design, and undertake verification and validation tests with critical appraisal of methodology.		

LEARNING OUTCOMES

On successful completion of this module the trainee will achieve the following work based Learning Outcomes;

1. Use CAD software to translate a user concept into a full design
2. Produce a user specification
3. Undertake a literature review to inform the design process
4. Translate the user specification into a design
5. Design and undertake verification and validation tests on a design
6. Critically evaluate their proposed methodology

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The following section provides detail of expected achievements in both practical and knowledge based learning outcomes for this module.

Required achievements are cross-referenced to the above Learning Outcomes to ensure application of competence across all activities within this module and thus maintain an integrated and holistic approach to development and assessment.

CLINICAL EXPERIENTIAL LEARNING

The recommended examples of clinical experiential learning for this module are

- Produce a specification from a design brief
- Produce a CAD drawing from a specification
- Take a design through manufacture and validate the prototype

All of these experiences should be recorded in your e-portfolio as reflective learning and discussions with your training officers.

Requirements for Professional Practice are contextualised to ensure the application and assessment of broad descriptors contained within Good Scientific Practice.

KEY LEARNING OUTCOMES	COMPETENCES	KNOWLEDGE AND UNDERSTANDING
1	Competently use a CAD software package to produce design drawings.	Design methodologies Methods of risk analysis Safety test requirements and methods
2	Specify manufacturing & machining for production tasks.	How to Specify, design and construct equipment to meet appropriate safety standards Small scale engineering manufacturing techniques and good manufacturing practice Materials properties and fabrication methods
3	Translate informal description of a problem into a set of detailed user requirements	The Essential Requirements of the Medical Devices Directive The Risk Classification Rules of the Medical Devices Directive Technical standards underpinning the Medical Devices Directive Experimental design
3	Perform a literature search and extract, collate and present information in a structured way.	Sources of other guidance on design and good manufacturing practice Governance and approval policies and procedures within the organisation
3,4	Identify performance and functional requirements for a design or an application.	The requirements for equipment in the clinical environment The importance of the human / machine interface in the clinical environment Materials properties and fabrication methods
3,4	Identify different options for a design and assess merits of each separately	Impact analysis as applied to new ideas The framework for intellectual property protection and exploitation Applications of technology in other fields

4,5	Plan, set up and conduct bench experiments to validate concepts, components and systems.	Safety test requirements and methods Qualitative and quantitative methods that are applicable Means of assessing clinical outcomes
5	Plan and perform a design review	Scientific and engineering principles that are applicable and appropriate in a particular situation Scientific method
5	Plan and perform a validation study	
5	Apply statistical analyses to data and to draw conclusions. Present the results and their discussion in a structured manner and written format.	Statistical methods

Associated Behaviours and Professional Practice
The Healthcare Scientist operates to high standards of professionalism and demonstrates essential behaviours and personal qualities These are specified within ***Good Scientific Practice*** *and map to the professional standards needed for registration with the appropriate regulatory bodies.* *These include areas such as communication and Health and Safety that complement and test application of the academic learning. These qualities need to be assessed throughout the work based assessment programme and will be demonstrated using appropriate assessment tools (DOPs and CBDs). Appendix 1 contains the summary of these professional qualities* *The key professional qualities for this module are contextualised below*.
✓ Communicate complex and technical information to patients and those with limited technical knowledge in terms that facilitate understanding of issues ✓ Ensure validation of data, through use of appropriate sources of information including relevant databases and consultation with senior colleagues ✓ Evaluate data from a range of analysis, information and personal support sources to assist with judgements and decisions on interpretation, extended testing, reporting and communicating results ✓ Make use of suitable range of diagnostic, investigative and/or monitoring procedures when undertaking investigations ✓ Produce a range of written reports in accordance with personal level/sphere of responsibility ✓ Use the appropriate range of IT platforms and software to ensure effective and comprehensive data collection and analysis Audit scientific practice within all areas of practice associated with investigations to ensure application of ethical and governance regulations ✓ Accept the responsibilities of the role of the scientist in relation to other health care professionals and with empathy and sensitivity to patients, carers and families ✓ Prioritise and organise workload and duties with due regard for urgency, patient care, safe practice and the optimisation of department workload. ✓ Work effectively and efficiently within a multi-disciplinary team with due regard for the needs, wishes, dignity and privacy of patients and their families

SECTION 4

The Learning Framework

The following section provides the framework for the design, delivery and assessment of learning and performance outcomes and associated knowledge and skills.
The framework provides a specification for each rotation and then for the specialist component of the programme
All of the underpinning academic knowledge will be taught as part of the Masters programme delivered by the academic provider

Rotational Modules

REHABILITATION ENGINEERING

Rotation Module

MODULE TITLE	Clinical Engineering Rehabilitation engineering	COMPONENT	Rotation
AIM	To allow the trainee to experience a wide range of clinical services and subject areas both to allow them to work effectively in the clinical setting and to assist them in choosing their future area of specialisation.		
SCOPE	On completion of this module the trainee will have gained an overview of the range of work activities associated with Rehabilitation Engineering and developed a working knowledge of both normal and impaired human musculoskeletal and neurological systems. They will have experienced the provision of a range of clinical services and be able to develop preliminary recommendations for interventions.		

LEARNING OUTCOMES

On successful completion of this module the trainee will achieve the following work based Learning Outcomes;

In each of the following fields:

- Aids for daily living
- Clinical gait analysis (CGA)
- Electronic assistive technology (EAT)
- Functional Electrical Stimulation (FES)
- Postural management
- Prosthetics and orthotics
- Wheelchairs

1. Develop a working knowledge of both the normal and impaired human musculoskeletal and neurological system, being able to describe a range of conditions and their functional implications.
2. Experience and take an active role in the provision of a range of clinical services, including the utilisation of a range of measurement techniques.
3. Develop preliminary recommendations for intervention and rationale for each.

The following section provides detail of expected achievements in both practical and knowledge based learning outcomes for this module.
Required achievements are cross-referenced to the above Learning Outcomes to ensure application of competence across all activities within this module and thus maintain an integrated and holistic approach to development and assessment.

CLINICAL EXPERIENTIAL LEARNING

The recommended examples of clinical experiential learning for this module are

- Participate in CGA assessment, process the data obtained and complete for the reporting clinical scientist a real or Strategic Health Authority report including options of kinematic, kinetic and/or visual assessment.
- Participate in a posture management assessment and complete for the reporting clinical scientist a real or Strategic Health Authority report including recommendations and rationale for each. This might include wheelchair seating, static seating and/or bed positioning, as applicable.
- Participate in the provision of a piece of posture management equipment.
- Participate in a wheelchair assessment and complete for the reporting clinical scientist a real or Strategic Health Authority report, including recommendations and rationale for each. This might include manual and/or powered wheelchairs, as applicable.
- Participate in the provision of a wheelchair and any associated equipment.
- Observe a clinical assessment for and the provision of an EAT system.
- Observe a clinical assessment for and the provision of a FES system.
- Observe a clinical assessment for and the provision of an orthosis.
- Observe a clinical assessment for and the provision of a prosthesis.
- Observe an occupational therapy clinical assessment of patient needs for an aid for daily living.

N.B. Due to the restricted length of the rotation, it is anticipated that involvement with assessment and provision of equipment may relate to different episodes of care.

All of these experiences should be recorded in your e-portfolio as reflective learning and discussions with your training officers.

Requirements for Professional Practice are contextualised to ensure the application and assessment of broad descriptors contained within Good Scientific Practice.

KEY LEARNING OUTCOMES	COMPETENCES	KNOWLEDGE AND UNDERSTANDING
1	Describe the functional implications of the main disabling conditions relevant to the clinical placement	The normal human musculoskeletal and neurological system, including child development relevant to the clinical placement. The pathology and mechanisms of disease and of the disabling conditions that give rise to motor / control deficits for a range of musculoskeletal and neurological conditions relevant to the clinical placement.
1,2	Lead a patient assessment relative to the clinical placement being undertaken; identify and define individual requirements for intervention; discuss with the patient and clinic team the realistic expectations of the intervention and the expected levels of enhancement	The range of investigations to be undertaken Basic principles of bio-mechanics. Disabling conditions which may result in referral and their common causes and prognoses Factors affecting the suitability and effectiveness of possible interventions The nature, type and extent of measurements and other forms of data required Requirements for attendance at the assessment by other members of multi-disciplinary teams How to check that equipment used for measurement is correctly calibrated and fully operational within expected parameters Capabilities and limitations of measurement instrumentation Environmental factors which influence function, capacity and social interaction of users Methods of communication with disabled people Where, how and when to seek advice and information from colleagues and relevant agencies The type and extent of records required for individual assessment and how to complete them Requirements and format for assessment reports
1,2	Use a variety of clinical methods to assess biomechanics and function (e.g. forces, active and passive joint	Anthropomorphic and physiological cost/effort measurements

	movement, motor assessment, muscle activity, interface pressure, Strategic Health Authority and energy expenditure) taking into account the complete clinical picture	- Measurements of tissue interface, range and accuracy of movement, type, stability, strength, spasticity, posture and function - Review of current status, regarding perceptual, physical, sensory and cognitive abilities, current treatment plan - Environmental factors (user environment), existing equipment and devices Solutions considered may include – rehabilitative/assistive technology, biomechanical technology or other intervention provided through multi-disciplinary teams
2,3	Develop objectives, recommendations and rationale for intervention	Options for action where the original referral proves to be appropriate or where additional issues have been identified Goal setting and measurement methods How to apply principles of biomechanics Personal level of competence, responsibility and authority for assessment and management of disabilities Normal and pathological principles of functional anatomy, physiology and their application in determining investigations for individual Fundamental engineering principles and practice
2,3	Make appropriate adjustments to equipment or its application to enhance function, comfort and safety	The product range relevant to the clinical condition and status of the patient Principles and applications of assistive technology devices Engineering systems relevant to assistive technology, e.g. wheelchair control systems, communication aids, environmental control systems and aids to daily living Principles and application of the interventions being considered Sources of information on the required product range and how to access these How to interpret data from patient assessments and the significance of interacting factors

Associated Behaviours and Professional Practice
The Healthcare Scientist operates to high standards of professionalism and demonstrates essential behaviours and personal qualities These are specified within ***Good Scientific Practice*** *and map to the professional standards needed for registration with the appropriate regulatory bodies.* *These include areas such as communication and Health and Safety that complement and test application of the academic learning. These qualities need to be assessed throughout the work based assessment programme and will be demonstrated using appropriate assessment tools (DOPs and CBDs). Appendix 1 contains the summary of these professional qualities* *The key professional qualities for this module are contextualised below*.
✓ Communicate complex and technical information to patients and those with limited technical knowledge in terms that facilitate understanding of issues ✓ Ensure validation of data, through use of appropriate sources of information including relevant databases and consultation with senior colleagues ✓ Evaluate data from a range of analysis, information and personal support sources to assist with judgements and decisions on interpretation, extended testing, reporting and communicating results ✓ Make use of suitable range of diagnostic, investigative and/or monitoring procedures when undertaking investigations ✓ Produce a range of written reports in accordance with personal level/sphere of responsibility ✓ Use the appropriate range of IT platforms and software to ensure effective and comprehensive data collection and analysis ✓ Audit scientific practice within all areas of practice associated with investigations to ensure application of ethical and governance regulations ✓ Accept the responsibilities of the role of the scientist in relation to other health care professionals and with empathy and sensitivity to patients, carers and families ✓ Prioritise and organise workload and duties with due regard for urgency, patient care, safe practice and the optimisation of department workload. ✓ Work effectively and efficiently within a multi-disciplinary team with due regard for the needs, wishes, dignity and privacy of patients and their families

SECTION 4

The Learning Framework

The following section provides the framework for the design, delivery and assessment of learning and performance outcomes and associated knowledge and skills.
The framework provides a specification for each rotation and then for the specialist component of the programme
All of the underpinning academic knowledge will be taught as part of the Masters programme delivered by the academic provider

Rotational Module

DEVICE RISK MANAGEMENT AND GOVERNANCE

Rotation Module

MODULE TITLE	Clinical Engineering Device Risk management and Governance	COMPONENT	Rotation
AIM	To introduce the trainee to the history, principles and practice of a Medical Device Management service within the healthcare environment. The module will outline key service elements and associated safety standards in the context of the healthcare environment the Trainee is working in.		
SCOPE	The principal aim is to allow the trainee to experience a wide range of clinical services and subject areas both to allow them to work effectively in the clinical setting and to assist them in choosing their future area of specialisation		

LEARNING OUTCOMES

On successful completion of this module the trainee will achieve the following work based Learning Outcomes;

1. Be aware and understand the prevailing standards, regulations and professional best practice in medical device management. Inc, patient safety and device safety notices.
2. Describe the key elements of an equipment management service. Inc, Planned Preventative Maintenance (PPM), repair, database management and manipulation for the generation of Key Performance Indicators (KPIs).
3. Understand the practical relevance of safety standards and be aware how to access and interpret them, specifically including the IEC 60601 family of electro-medical safety standards.
4. Understand local healthcare environment and range of services offered by the institution and the existence of relevant policies and procedures.
5. Understand the medical device information system, and practical experience of using the database.
6. Understand the local and national procurement processes which must be adhered to when purchasing new or replacement medical devices.
7. Understand the national standards of clinical governance and risk as applied to medical device management. Able to discuss risk management strategies within the institution in relation to practical experience of carrying out a risk assessment.

CLINICAL EXPERIENTIAL LEARNING

The following section provides detail of expected achievements in both practical and knowledge based learning outcomes for this module.

Required achievements are cross-referenced to the above Learning Outcomes to ensure application of competence across all activities within this module and thus maintain an integrated and holistic approach to development and assessment.

The recommended examples of clinical experiential learning for this module are

- Complete a real or shadow change to a standard operating procedure (SOP) to meet the requirements of a new or previously updated harmonised standard.
- Carry out functional and electrical safety tests on a range of medical devices, ensuring a range of devices are included, e.g. infusion devices, electrosurgical, monitoring and anaesthetic equipment. Observe an electrical safety test on a medical electrical system as per the requirements of the regulatory safety standards.
- Carry out and report on an audit of a particular type of medical device. This may include an evaluation of service records, incidents, training issues and standardisation.
- Discuss and evaluate the stages of managing a procurement project for medical devices. This may include device specification, standing financial instructions (SFI), technical, clinical and financial evaluations, and the acceptance process for getting the selected device into clinical use.
- Complete a real or shadow risk assessment report.

All of these experiences should be recorded in your e-portfolio as reflective learning and discussions with your training officers.

Requirements for Professional Practice are contextualised to ensure the application and assessment of broad descriptors contained within Good Scientific Practice.

KEY LEARNING OUTCOMES	COMPETENCES	KNOWLEDGE AND UNDERSTANDING
1.	Describe the key elements of a Medical Device Management Service and evaluate a clinical example applied to a specific piece of equipment	Key service elements and associated safety standards in the context of the healthcare environment Be aware of the correct operation of a wide range of medical devices. Be aware of how the medical device may operate to facilitate physiological function in the patient with pathology and have an understanding of the physiological function in a healthy subject.
1,2	Describe and discuss professional best practice, prevailing national standards and the regulatory requirement in a Medical Device Management Service	The legislative and regulatory framework covering the supply, installation and maintenance of medical equipment The sources of advice and information both official governmental and other sources Product Liability and Health & Safety legislation and its impact upon service provision How to access MHRA and other published sources of evaluation and assessment information Regulatory requirements as applied to clinical trials Have a working knowledge of the Medical Devices Directive, and understand the risks associated with modifying a medical device Purpose of the Medical Devices Directive , the implications of MHRA Bulletin 18 The requirements for Clinical Evaluation incorporated within the MDD Be able to interpret safety alerts Be aware of local policy for incident reporting Be aware of national policy for incident reporting to the MHRA
3	Give an overview of the electro-medical family of standards and their use in a Medical Device Management Service	The practical relevance of safety standards and be aware how to access and interpret them, specifically including the IEC 60601 family of electro-medical safety standards. Use a medical device safety tester to perform tests on a range of equipment types, including devices of Class 1 & 2 and with type B,BF & CF applied parts Have an awareness of the process to test medical electrical systems
3,4	Describe and discuss the organisations policies associated with a Medical Device Management Service	The clinical governance framework and corporate objectives of the organisation The requirement of the relevant Quality Management System The requirement of processes, work instructions and standard operating procedures. The requirement for monitoring customer satisfaction
5	Competently navigate and use the	Access specific equipment types for information from the medical device information

	Organisation's Medical Device Information System to display or extract essential asset related information	system, demonstrating an understanding of equipment classification. Describe some typical Key Performance Indicators that could be extracted from a Medical Device Information System Use the Institution's Medical Device Information System to log an equipment fault or associated service request Produce a range of simple asset based reports Illustrate how to label equipment accordingly Discuss how to choose test equipment, including the need for calibrated versus indicating devices Complete service records comprehensively and legibly Discuss traceability of product in the maintenance process Demonstrate awareness of H&S risks in the workshop and clinical environments whilst maintenance activities are undertaken
6	Describe and discuss the local and national procurement procedures for the purchase of medical equipment from specifying device requirements to accepting the equipment into the trust.	Principles of use and operation of equipment type to be commissioned Clinical setting, intended purpose and expected performance parameters of commissioned equipment Utility requirements of the medical equipment to be installed Network requirements and the appropriate contact staff in IT departments Loading capability of the structure (e.g. walls, floors or medical rails) to which the medical equipment will be mounted What mounting solutions for medical equipment are commercially available Different configuration options and their implications The range, type and number of accessories, ancillary devices and manuals required for commissioning The measurement principles and limitations of the test equipment used Type and application of acceptance checks Data required to register equipment and implement repair and maintenance warranties The training and development needs of clinical users Procedures for handover for clinical service Procedures for recording user training Procedures for managing problems arising with commissioning of equipment and the range of corrective action and the process of rejecting equipment
	Undertake functional and electrical safety	Principles of use and operation of equipment type to be commissioned Clinical setting, intended purpose and expected performance parameters of

	testing on a range of medical devices	commissioned equipment Utility requirements of the medical equipment to be installed The measurement principles and limitations of the test equipment used
6	Perform a risk assessment on a piece of equipment or a service related issue in accordance with ISO 14971 and local Trust risk management policies and procedures.	How to assess the value of existing and new techniques Formal and informal techniques for the assessment of risk Formal and informal techniques for the assessment of benefit The principles of the technology used in the equipment under consideration The clinical implications and use of the equipment under consideration The measurement principles and limitations of test equipment used Legislative and regulatory framework for equipment under consideration Range and type of evaluation methods and how to match these to type and complexity of equipment under consideration How to establish evaluation criteria relevant to equipment functionality, performance, intended use and clinical context How and where to obtain expert advice How to assess training implications of new and emerging techniques The type, range and level of detail of data required to enable a decision on safety and effectiveness of equipment Peripheral issues affecting use and cost of equipment under consideration, including location, environment, consumables, risks, training requirements The healthcare context of the relevant area of clinical medicine Clinical risks associated with the use of equipment To an appropriate level, the anatomy, physiology and disease processes or deficits in the relevant area of clinical medicine Individual level of authority and competence The role, capabilities and limitations of medical equipment in clinical environment and the contexts in which it is used Common causes of equipment failure and misuse Technical, safety and regulatory guidance and obligations with respect to medical facilities; (electrical installations, emergency power requirements, piped gas and suction supplies, decontamination requirements, ancillary services, etc.)

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SECTION 4
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Rotational Modules

CLINICAL MEASUREMENT AND DEVELOPMENT

Rotation Module

MODULE TITLE	Clinical Engineering **Clinical Measurement and ICT**	**COMPONENT**	**Rotation**
AIM	To ensure that the trainee can apply analytical and judgement skill to novel or complex clinical measurements and implement new clinical measurement solutions and understand and configure novel ICT hardware and software solutions safely within in clinical environment		

LEARNING OUTCOMES

On successful completion of this module the trainee will achieve the following work based Learning Outcomes;

1. Acquire clinical measurement data effectively and safely
2. Be aware of the scientific and clinical principles underpinning a range of basic clinical measurements
3. Be confident in the statistical treatment and interpretation of clinical measurement data
4. Understand the role of ICT hardware, software and network components within the context of Medical Physics and Clinical Engineering
5. Maintain PC software installations and local area networks
6. Be fluent in data manipulation using: a spreadsheet environment; ii. an appropriate programming language
7. Understand the main issues of security and data governance in ICT within the context of Medical Physics and Clinical Engineering

The learning outcomes and competencies in this module run through and are integrated into the other 3 disciplines.

CLINICAL EXPERIENTIAL LEARNING

The following section provides detail of expected achievements in both practical and knowledge based learning outcomes for this module.

Required achievements are cross-referenced to the above Learning Outcomes to ensure application of competence across all activities within this module and thus maintain an integrated and holistic approach to development and assessment.

The recommended examples of clinical experiential learning for this module are:

- Participate in undertaking novel or complex clinical measurements in the patient environment
- Analyse, summarise and present complex data using computer software
- Installation of system and applications software on a void PC
- The administration of a local area network (user specification; initial set-up; Shared resources; security issues)
- Programming using an appropriate language (e.g. MS VB, MS VBA-Excel, Matlab, Java) to reduce and report clinical measurement or other laboratory data

All of these experiences should be recorded in your e-portfolio as reflective learning and discussions with your training officers.

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KEY LEARNING OUTCOMES	COMPETENCES	KNOWLEDGE AND UNDERSTANDING
1	Set up equipment for taking clinical measurements	An understanding of the physics underpinning the measurement of electrical signals from patients An understanding of the technical, scientific and clinical basis of clinical measurements Confidence in dealing with patients in an efficiently and safely Able to identify sources of appropriate literature relating to the technical, scientific and clinical basis of clinical measurements Confidence in applying appropriate statistical tests to clinical measuring data with an appreciation of accuracy, precision, resolution and bias
1	Participate in undertaking novel or complex clinical measurements in the patient environment	
2,3	Undertake a literature review of the scientific and clinical evidence base that underpins the test	
2,3	Analyse data and report on the use of specific measurement (particularly in terms of accuracy, reproducibility, bias, specificity and sensitivity)	
3	Critically appraise reports from a novel or complex clinical measurement	
3	Recognise technical artefacts and deterioration in equipment performance	
1-3	Observe and participate in a range of basic clinical measurements (ECG, EEG and EMG)	
4,5	Contribute at a professional level to clinical teams and communicate scientific material effectively to professional colleagues	
4,5	Analyse, summarise and present complex data using computer software, such as word-processing, spreadsheets, databases and online references sources for clinical and scientific applications	Understand the use of computing in the context of Medical Physics and Clinical Engineering The use of commonly available databases, spreadsheets and statistics packages

4,5	Discuss the operation of major ICT hardware, software and networking components	Administration of local area networks Understanding of IT security and data integrity Awareness of governance issues relating to patient data Awareness of the concept of a System in the context of electrical safety The governance issues relating to patient data Appropriate programming languages (e.g. C++, MS VB, MS VBA-Excel, Matlab, Java) Web development tools.
4,5,6	Participate in the implementation of ICT components in a controlled fashion taking into account the impact on existing facilities and clinical service.	
4,5,6	Participate in the maintenance of protective measures for ICT systems including disaster measures, anti-virus protection, maintenance, updating, firewalls and virtual servers/networks.	
4-7	Implement a novel application in a test environment	
4-7	Specify, design, develop and test a small spreadsheet, database or image processing solution.	
4-7	Specify, design and develop a web application	

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