MODERNISING SCIENTIFIC CAREERS

Scientist Training Programme

MSc in CLINICAL SCIENCE
Curriculum

CLINICAL ENGINEERING
2013/14

Modernising Scientific Careers
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READERSHIP

This Scientist Training Programme (STP) MSc Clinical Science curriculum describes the MSc Clinical Science programmes that, together with the work based learning guide, provide the details of each themed STP in the UK for:

- academic and administrative staff, including external examiners within Higher Education Institutions (HEIs);
- trainees, host departments and managers of services that employ healthcare science staff;
- work based trainers, including all those involved in supervising, mentoring, coordinating, assessing and delivering STP education and training;
- Local Education and Training Boards (LETBs) and all healthcare science education and training commissioning organisations in the UK;
- patients and the public;
- Modernising Scientific Careers (MSC) accreditation panels.

A glossary of terms used is provided in the Appendices.
Section 1: Introduction to Modernising Scientific Careers (MSC) and the Scientist Training Programme (STP)

1.1 Introduction to Modernising Scientific Careers (MSC)

1. The healthcare science (HCS) workforce plays a central role in safe and effective patient care across all pathways of care from health and wellbeing to end of life. There are approximately 55,000 employees in the healthcare science workforce in the NHS in the UK, and approximately 80% of all diagnoses can be attributed to their work.

2. Healthcare science involves the application of science, technology and engineering to health. *Good Scientific Practice* (GSP) [Appendix 3] sets out the principles and values on which good practice within healthcare science is founded. It makes explicit the professional standards of behaviour and practice that must be achieved and maintained by all those who work in healthcare science. GSP and the Education and Training Standards of the Health and Care Professions Council (HCPC) together form 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 twelve STP themes within healthcare science, which enables training across a total of 28 healthcare science specialisms, with curricula for additional specialisms still under development.

1.2 Introduction to the Scientist Training Programme (STP)

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. STP is a three-year pre-registration postgraduate academic (MSc Clinical Science) and work based programme.

5. Recruitment to the programme is competitive, and in England a national recruitment process is led by the National School of Healthcare Science (NSHCS). Following induction, workplace training commences with a rotational training programme in a themed group of up to four healthcare science specialisms, followed by training in a specific specialism.
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 NSHCS. Graduates are 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.

1.3 Scientist Training Programme Outcomes: 2013/14

Graduates of the STP will possess the essential knowledge, skills, experience and attributes required of a newly qualified Clinical Scientist. STP graduates 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 be competent to undertake complex scientific and clinical roles, defining and choosing investigative and clinical options, and making key judgements about complex facts and clinical situations within a quality assurance framework. 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/or education and training.

On completion of the STP all graduates should be able to demonstrate the following.

Professional Practice

1. Professional practice that meets the professional standards of conduct, performance and ethics defined by Good Scientific Practice and the regulator (HCPC), and is safe, lawful and effective, and within the scope of practice for the role undertaken, while maintaining fitness to practise.
2. Personal qualities that encompass communication skills, self-management, self-awareness, acting with integrity and the ability to take responsibility for self-directed learning, maintaining their own health and wellbeing, critical reflection and action planning to maintain and improve performance.
3. The ability to be an independent self-directed learner acting autonomously in a non-discriminatory manner when planning and implementing tasks at a professional level, contributing to the education and training of colleagues and providing mentoring, supervision and support as appropriate.
4. The ability to work, where appropriate, in partnership with other professionals, often as part of a multidisciplinary team, supporting staff, service users and their relatives and carers while maintaining confidentiality.
5. The ability to work with public, service users, patients and their carers as partners in their care, embracing and valuing diversity.

Scientific and Clinical Practice

6. A systematic understanding of relevant knowledge, and a critical awareness of current problems, future developments 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.
7. High-quality clinical and scientific practice that applies basic, core scientific 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.

8. The ability to perform quality assured appropriate diagnostic or monitoring procedures, treatment, therapy or other actions safely and skilfully, adhering to applicable legislation and in compliance with local, national and international guidelines.

9. The ability to deal with complex scientific and clinical issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences, including patients and the public.

10. The ability to define and choose investigative and scientific and/or clinical options, and make key judgements about complex facts in a range of situations.

11. 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 knowledge in healthcare and healthcare science and their specialism.

Research, Development and Innovation

12. 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, audit, innovation and service development, which either directly or indirectly leads to improvements in patient experience, clinical outcomes and scientific practice.

13. Conceptual understanding and advanced scholarship in their specialism, enabling them to critically evaluate and critique current research and innovation methodologies and, where appropriate, propose new research questions and hypotheses.

Clinical Leadership

14. Scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.

15. The ability to critique, 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.
1.4 Overview of the MSc Clinical Science Programme

7. This document sets out the proposed structure, high-level learning outcomes and indicative content for the proposed three-year, part-time Masters in Clinical Sciences that forms part of the Scientist Training Programme (STP). The programme combines and integrates the generic professional practice learning, themed learning in a group of specialisms and individual specialist programmes.

8. Figure 1 depicts the overall structure and timing of each STP programme while Figure 2 depicts the broad framework around which all MSc Clinical Science programmes must be structured. However, each division within the Modernising Scientific Careers Programme (MSC) has interpreted and adapted this framework.

Figure 1: Modernising Scientific Careers: Scientist Training Programme (STP): Diagrammatic representation of employment-based, pre-registration, three-year NHS-commissioned education and training programme
### Figure 2: High-Level Framework for MSc Clinical Science

<table>
<thead>
<tr>
<th>Year 3 Specialist Practice</th>
<th>Healthcare Science</th>
<th>Research Project</th>
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<td></td>
<td>Specialist Learning with integrated Professional Practice</td>
<td>Students would usually begin a work based research project in Year 2 and complete the project in Year 3</td>
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<th>Year 2 Specialist Practice</th>
<th>Research Methods</th>
<th>Healthcare Science</th>
<th>Research Project</th>
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<td>[10]</td>
<td>Specialist Learning with integrated Professional Practice</td>
<td>Students would usually begin a work based research project in Year 2 and complete the project in Year 3</td>
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<th>Year 1 Core Modules</th>
<th>Healthcare Science</th>
<th>Healthcare Science</th>
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<tr>
<td></td>
<td>Integrating science and Professional Practice</td>
<td>Integrating underpinning knowledge required for each rotational element with Professional Practice</td>
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<table>
<thead>
<tr>
<th>Generic</th>
<th>Division/Theme</th>
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- **Generic Modules**: Common to all divisions of healthcare science
- **Division/Theme-Specific Modules**: Common to a division or theme
- **Specialist Modules**: Specific to a specialism
Section 2: Entry Routes, Award Title, Delivery, Accreditation of Prior Learning

2.1 Entry Routes

9. In England there are two routes of entry into STP. Through the direct entry route, the trainee will be competitively appointed. Alternatively, some STP trainees may enter into training with support of their employers through an in-service training route, as long as employers can demonstrate the ability to support STP training by meeting work based accreditation standards. In both cases potential STP applicants must participate in the national recruitment/assessment process and meet the minimum entry requirements for the academic and work based programme. For direct entry applicants, this will be a competitive process, whereas in-service trainees will be required to go through the national recruitment process to ensure that they meet the standards for entry into STP.

2.2 Progression

10. No condonement/compensation of modules and no aggregation of marks are permitted. Students must pass all modules to be eligible for the final award.

2.3 Award Titles

11. The title of the degree programme should be consistent with current MSC terminology. The award titles are:

**Life Sciences**
- MSc Clinical Science (Blood Sciences)
- MSc Clinical Science (Cellular Sciences)
- MSc Clinical Science (Genetics)
- MSc Clinical Science (Infection Sciences)

**Physical Sciences and Biomedical Engineering**
- MSc Clinical Science (Medical Physics)
- MSc Clinical Science (Clinical Engineering)
- MSc Clinical Science (Reconstructive Science)
- MSc Clinical Science (Clinical Pharmaceutical Science)

**Physiological Sciences**
- MSc Clinical Science (Cardiac, Critical Care, Vascular, Respiratory and Sleep Sciences)
- MSc Clinical Science (Gastrointestinal Physiology and Urodynamic Science)
- MSc Clinical Science (Neurosensorv Sciences)

**Across all Divisions**
- MSc Clinical Science (Clinical Bioinformatics)

In accordance with their own discretion and regulations, HEIs may be able to seek a variation in the award title to enable the specialism to be identified. This
should be raised as part of MSC Accreditation and discussed with the commissioner.

2.4 Mode of Delivery: Part-time

2.5 Relevant Quality Assurance Agency (QAA) Code(s) of Practice

12. HEIs should adhere to the current QAA Code of Practice for the Assurance of Academic Quality and Standards in Higher Education. At the time of preparing this document the QAA is in the final stages of a major review of the Code of Practice and is expected to publish 'The UK Quality Code for Higher Education'. Further details can be found on the QAA website: http://www.qaa.ac.uk/Pages/default.aspx

2.6 Awarding Body

13. While the full programme could be delivered and awarded by a single university provider, equally a collaborative partnership between a number of universities may be preferable. It would be expected that where collaborative provision is proposed a memorandum of agreement or understanding is in place. The delivery arrangements must be clearly defined, including the academic and logistical responsibilities of each partner and the financial arrangements between the university and its partner. The awarding university must satisfy itself that the partner is able to discharge its responsibilities satisfactorily and will be responsible for the quality assurance of the programme.

2.7 Accreditation of Prior Learning

14. A process for Accreditation of Prior Learning (APL) that conforms to the guidelines below must be defined by each HEI provider. This must clearly define the minimum and maximum level of APL that will be awarded, the timing, costs and process, and align to statutory requirements for healthcare science. Good practice supports the view that such prior learning should only be used once, double counting is not recommended.

QAA ‘Higher education credit framework for England: guidance on academic credit arrangements in higher education in England’, August 2008

QAA ‘Guidelines on the accreditation of prior learning’, September 2004

HCPC ‘Standards of education and training’, September 2009
http://www.hpc-uk.org/aboutregistration/standards/sets/
2.8 Programme Delivery and Monitoring

15. The tender and subsequent MSC accreditation process will require an HEI to provide a detailed description of the content of each module and the teaching and learning and assessment strategy to demonstrate how the programme and module aims/learning outcomes will be met.
Section 3: The MSc Clinical Science Curriculum

3.1 Purpose

16. The purpose of the STP MSc curriculum is to clearly set out the expectations of graduates from the programme, including the academic skills, knowledge and understanding that each trainee will be expected to gain, develop and apply during work based training. Set within an integrated academic and work based programme the expectations of all MSc programmes should be read alongside the work based learning guides.

Additionally, the purpose is to signal the importance of providers being aware of the current structure, strategic direction and priorities of healthcare delivery in the UK, for example the NHS Constitution. The requirement to prioritise patients and their care and ensure that the patient and service provided by healthcare science is at the centre of all learning, assessment and work based practice is equally important.

3.2 Curriculum Development and Maintenance

17. Curriculum development began in 2010 and has been led by the Modernising Scientific Careers (MSC) team working with NHS and higher education colleagues and patients. Since 2012 the NSHCS has also contributed to curriculum development and maintenance via the professional leads and each of the NSHCS themed boards. Professional bodies have been represented in some curriculum working groups and have also been invited to provide feedback as the work developed, either directly or via the NSHCS themed boards.

All programmes have also been reviewed and approved by Health Education England via the Healthcare Science Professional Board Education and Training Working Group. External feedback from a review undertaken in 2012 by the Institute of Education has been incorporated into all programmes from 2013 onwards. All of the latest versions of the MSc Clinical Science programmes and work based learning guides can be found on the NHS Networks website by following the link: http://www.networks.nhs.uk/nhs-networks/msc-framework-curricula

All MSC curricula will be subject to regular review, with all stakeholders given the opportunity to contribute to each review. This process is currently being set out in an MSC long-term curriculum maintenance plan.

18. STP MSc Clinical Science programmes leading to an academic award must be aligned to current NHS policy and strategy, and at the time of writing this guide should consider the recommendations of:

- Strategy for UK Life Sciences (December 2011)
• Strategy for UK Life Sciences One Year On (2012)
• Innovation Health and Wealth, Accelerating Adoption and Diffusion in the NHS (December 2011)
• NHS Commissioning Board planning guidance http://www.commissioningboard.nhs.uk/files/2012/12/everyonecounts-planning.pdf
• HEE Design to Delivery that will give you the statutory basis and duties of HEE http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_132087.pdf

HEIs should ensure they keep abreast of future strategic direction and policy.

3.3 Tender Process and Monitoring

19. Local Education and Training Boards are responsible for the commissioning of MSc Clinical Science programmes and the quality of each programme. The lead commissioner function for MSC programmes sits within the West Midlands.

3.4 MSC Accreditation

20. All MSc Clinical Science programmes must hold MSC Accreditation to confirm that commissioned MSc in Clinical Science programmes delivered by an HEI meet the requirements of the MSC Scientist Training Programme outlined in Modernising Scientific Careers: The UK Way Forward (DH, 2010). This accreditation process is currently the responsibility of the MSC Accreditation team, with advice given by the Health Education England Healthcare Science Professional Board (HEE HCSPB) and its Education and Training Working Group (HEE HCSPB ETWG).

3.5 Programme Delivery

21. HEIs are expected to ensure that all teaching, learning and assessment is up to date and informed by research to ensure that at graduation, Clinical Scientists meet the Framework for Higher Education Qualifications (FHEQ) descriptor at level 7 (http://www.qaa.ac.uk/). By undertaking a substantive research project bearing 60 credits, students should become aware of the major contribution the healthcare science workforce makes to research and innovation to benefit patients and the delivery of healthcare.
22. The key principles include:

- programmes must deliver the MSC learning outcomes and indicative content, which the HEE HCSPB Education and Training Working Group has advised meets the requirements of *Modernising Scientific Careers: The UK Way Forward*;
- wherever possible, delivery of the principles and knowledge underpinning practice should occur before the work based learning;
- programmes must meet current NHS education quality metrics and current Health and Care Professions Council (HCPC) Standards of Education and Training;
- the NSHCS, host departments, patients and the public should be involved in the design, implementation, delivery and review;
- assessment programmes must be fair, valid and reliable, and clearly articulated for all modules, and the timing and content should consider and complement the work based assessment programme;
- a robust student support and mentoring system must be in place and arrangements to support students in difficulty agreed with the NSHCS;
- a high-quality teaching and learning environment with appropriate resources and facilities to support teaching and research;
- teaching staff who are research active with a track record of undertaking high-quality research of national and international standing that is relevant to the practice of healthcare science and the NHS;
- evidence that each MSc programme meets the equivalent of the relevant HCPC Standards of Education and Training.

23. The Professional Practice and Good Scientific Practice underpin the MSc and work based programme. Key professional practice learning outcomes are included in the MSc programme and it is important that the MSc programme embeds the standards of professionalism set out in Good Scientific Practice in all aspects of the delivery and assessment of the programme. Trainees should be encouraged to develop a range of skills to support their professional life, and continuing professional development spanning communication, leadership, personal reflection, duty of care, duty of candour, critical reflection, giving and receiving feedback, career planning, commitment to lifelong learning.

HEIs should ensure that all staff involved in each MSc programme have read and are aware of the requirements of *Good Scientific Practice*, a copy of which can be found in the Appendices.

3.6 Academic Induction

24. It is expected that there will be a period of academic induction at the start of each MSc programme.

3.7 Teaching and Learning
25. It is expected that a blended learning approach will be adopted, based on a model of student-centred adult learning that balances and integrates face-to-face teaching, e-learning, etc., and considers the broader requirements of each STP. It is expected that a broad range of teaching and learning activities will be utilised, appropriate to the learning outcomes. Trainees should be enabled to gain the skills necessary to manage their own learning, and to exercise initiative and personal and professional responsibility. The learning strategy matrix and proformas outlined in ‘Liberating Learning’\(^1\) describe a range of activities that may be appropriate to this MSc programme; they are likely to include:

- Advanced library study
- Case study/discussions
- Debate
- Discussion forum
- Expert briefings
- Individual tutoring
- Interactive lectures
- Personal critical reflection and action planning
- Problem-based learning
- Role play
- Student-led and tutor-led seminars
- Skills teaching
- Simulation
- Self-assessment
- Self-directed learning activities
- Team projects
- Tutor-led small group learning

26. It is also expected that e-learning and m-learning\(^2\) opportunities will be available to enable students to be active participants in a range of learning activities. Work based learning will also contribute to the academic educational experience of the trainees, for example seminars, journal clubs, local, national and international scientific and education meetings.

All contributors to the MSc should have up-to-date knowledge of the requirements of the programme, current healthcare science and education practice.

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\(^2\) JISC TechDis: see [http://www.jisctechdis.ac.uk/technologymatters/mobilelearning](http://www.jisctechdis.ac.uk/technologymatters/mobilelearning) for further information with respect to mobile (m) learning.
3.8 Interprofessional Learning

27. Opportunities to enable interprofessional and interdisciplinary learning, within and outside healthcare science, should be a fundamental part of each programme.

3.9 Patient and Public Involvement

28. The HEI programme team should have mechanisms in place to ensure that there is meaningful patient and public involvement in the design, delivery, development and quality assurance of each programme. It is expected that patients will be represented on course committees at all levels and contribute to teaching, learning and assessment.

Descriptions of MSc programmes need to make clear and explicit links to new models of service delivery, care and patient pathways. The delivery of high-quality, compassionate, patient-centred care should be an integral part of each degree programme, with the emphasis on the contribution of the healthcare science workforce to ensure trainees are aware that their actions have an impact on the patient and the patient's family. The responsibility of all staff in the NHS to maximise quality and productivity and efficiency and to continually strive to improve services should be stressed. Equally important is the ability of graduates from the STP to communicate with the general public with respect to healthcare science, leading to a better educated public that is encouraged to take responsibility for its own health and wellbeing and has a greater understanding of the role that science plays in society.
Section 4: Assessment

4.1 Purpose of Assessment

29. The purpose of assessment is to enable the trainee to demonstrate that they have the requisite knowledge, skills, attitudes and beliefs to work as a Clinical Scientist and, together with the successful graduation from the work based element of the STP, that they meet the HCPC standards of education and training, professional skills, conduct performance and ethics to provide reassurance to the public.

30. The MSc Clinical Science assessment programme should support assessment for learning, and in particular:

- help clarify what good performance is (goals, criteria, standards);
- encourage ‘time and effort’ on challenging learning tasks;
- deliver high-quality feedback information that helps learners to self-correct;
- encourage positive motivational beliefs and self-esteem;
- encourage interaction and dialogue around learning (peer and teacher–student);
- facilitate the development of self-assessment and reflection in learning;
- involve students in decision making about assessment policy and practice;
- support the development of learning communities;
- integrate and complement the work based assessment programme;
- help teachers adapt teaching to student needs.

31. The HEI must have in place a clear, overarching strategic and systematic approach to assessment that fits with the curriculum and delivers assessment methods that are valid, reliable/generalisable, feasible, fair, acceptable and defensible, and is led by assessment experts. The approach to the assessment of the MSc Clinical Science should also be cognisant of and complement the work based assessment programme.

32. The assessment programme should be designed to enable the trainee to obtain regular constructive feedback on progress and achievement. It should encourage critical reflection and action planning, identifying both strengths and areas for development and improvement.

33. The approach to assessment should include and be overseen by a central coordinating leadership group or assessment-focused group who oversee, advise and scrutinise assessment across modules and years in order to build a consistent approach to assessment across the whole programme, involving module/programme leaders as appropriate. The overall assessment strategy

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3 Quality Assurance Agency Code of Practice.

should be documented in a clear and accessible manner with accountabilities clearly allocated. The strategy should also demonstrate how the approach is based on a sound understanding of the evidence base, academic literature and good practice in assessment.

4.2 **Key areas that must be covered by the Assessment Strategy include:**

- A clear statement of accountabilities, including the governance structure for assessment.
- The balance between formative and summative assessment.
- The assessment of each module, including the contribution of individual assessments and examinations within the module.
- Progression criteria.
- The range of valid, reliable and appropriate assessment techniques that will be utilised across the programme and for each module.
- The process for providing clear and timely information for students.
- How all examiners will be trained (including refresher training) and the guidelines that will be given.
- The mechanisms in place to ensure comparability of standards and to share good practice, including external examiners.
- How standard setting is undertaken.
- How student feedback will be given, including timelines.
- The arrangements for assessment of students with a disability.
- An assessment blueprint demonstrating the relationship between each assessment and the learning outcomes of the programme.
- Exemplar criteria and marking scheme, including critical reflective writing.
- The process of appointing external examiners.
- A defined role for external examiners that includes contributing to the review and development of assessment strategies and providing advice from an overarching perspective.
Section 5: Trainee Supervision, Support and Mentoring

34. The trainee supervision, support and mentoring systems will span the academic and work based elements of STP, and the relationship between the two systems must be clear to trainees, work based staff and HEI staff. The trainee supervision, support and mentoring system must be designed to encourage safe and effective practice, independent adult learning, appropriate professional conduct of the trainee and the safety of the patient. Those undertaking the role of supervisor or mentor must have relevant qualifications and experience and have undertaken appropriate and up-to-date training. The HEI will be expected to have an academic supervisory, support and mentoring scheme in place and to provide access to student support services.

Academic supervisor(s): Responsible, usually as part of a supervisory team, for guiding and assisting students during their period of academic study, including the research module.

Work based education supervisor: Responsible for monitoring, supporting and assessing the trainee on a day-to-day basis in their scientific, clinical and professional work and may take on the role of co-supervisor of the research project as part of the academic supervisory team.

5.1 Fitness to Practise

35. The HEI must have a clear policy with respect to Fitness to Practise, which must clearly articulate how staff and students are made aware of the policy and how the policy is implemented. Alongside this must be a clear policy on how student whistleblowers are supported. Breaches of professional practice and behaviour identified by the HEI or during HEI activities must be reported and investigated in accordance with this Fitness to Practise policy and accurate records maintained within the HEI. The NSCHCS should be informed of any issues with respect to fitness to practise and professional suitability.
Section 6: Progression, Annual Monitoring of Progress, Equality and Diversity, Curriculum Review and Updating

6.1 Progression

36. All trainees will usually be expected to complete the requirements for the MSc Clinical Science award within three years after initial registration (periods of suspension will not lead to an automatic extension of this period). This aligns with the duration of the STP and it is expected that successful STP graduates will be required to attain both an MSc in Clinical Science and certification of completion of STP work based training.

6.2 Annual Monitoring of Progress

37. The programme governance must include annual monitoring of progress that considers the outcome of the review of each module (including student and lay evaluation) and the handling and consideration of the external examiner’s report. This process should enable the programme leaders to identify and propose changes to the programme in response to feedback.

6.3 Equality and Diversity

38. All programmes should reference and be able to demonstrate evidence of adherence to the Disability Discrimination Act 1995 (DDA) which was extended to education in September 2002, following amendments introduced by the Special Educational Needs and Disability Act (SENDA) 2001. Additionally evidence should be demonstrated to show adherence to the Disability Discrimination Act (2005) which includes the Disability Equality Duty and the QAA Code of Practice on Students with Disabilities should be available. All degree programmes should also include evidence of adherence to the 2010 Equality Act and any superseding legislation with respect to equality.

As part of this commitment to equality staff should be committed to inspiring and supporting all those who work, train and provide training in healthcare science to operate in a fair, open and honest manner. The approach taken is a comprehensive one and reflects all areas of diversity, recognising the value of each individual. This means that no one is treated less favourably than anybody else on the grounds of ethnic origin, nationality, age, disability, gender, sexual orientation, race or religion. This reflects not only the letter but also the spirit of equality legislation, taking into account current equality legislation and good practice.

Key legislation includes:

- Race Relations Act 1976 and the Race Relations Amendment Act (RRAA) 2000
- Disability Discrimination Act 1995 and subsequent amendments
• Human Rights Act 1998
• Employment and Equality (Sexual Orientation) Regulations 2003
• Employment and Equality (Religion or Belief) Regulations 2003
• Gender Recognition Act 2004
• Employment Equality (Age) Regulations 2011.

6.4 Curriculum Review and Updating

39. The review and updating of the doctoral level academic award curriculum will be part of the long-term MSC curriculum maintenance programme currently being developed.

If you have any feedback with respect to this programme please contact: msc.hee@nhs.net
Section 7: Relationships and Partnerships

7.1 National School of Healthcare Science

40. The NSHCS provides a national coordinating and oversight function to support trainees and host departments in the delivery of STP 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 Online Learning and Assessment Tool (OLAT), supporting trainees in difficulty as well as coordinating 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 that 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 Strategic Health Authority (SHA) leads (and education and quality leads in the future arrangements) on local issues and problems and their resolution;
- working closely with workplace training departments and providing support as appropriate;
- organising national ‘Train the Trainer’ programmes to ensure common standards of delivery and content, and recommending ongoing training activities to support the continuing professional development of work based trainers.

41. 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.

7.2 The Academy for Healthcare Science

41. The Academy for Healthcare Science (AHCS provides the professional voice for the healthcare science workforce. Its functions are to:

- act as a strong and coherent professional voice;
• be able to influence and inform a range of stakeholders on all matters relating to healthcare science and scientific services;
• act as the overarching body for professional issues related to education, training and development in the UK health system including the provisions of UK wide quality assurance across education and training arrangements;
• provide the infrastructure to support the professional regulation/registration of the healthcare science workforce including:
  o establishing a system of professional accreditation of education and training programmes for the regulation/registration of the healthcare science workforce;
  o setting the professional standards for the delivery of accredited registers as required by CHRE (to be renamed the Professional Standards Authority for Health and Social Care) to ensure consistency and coherence across all MSC programmes;
  o taking the central role in the sponsorship of the voluntary registers to achieve ‘accredited’ status as set out by CHRE (to be renamed the Professional Standards Authority for Health and Social Care);
  o becoming an HPC education provider for the statutory regulation of clinical scientists;
  o establishing a system for equivalence across the whole of the healthcare science workforce.

http://www.academyforhealthcarescience.co.uk/

The following sections of this MSc Curriculum provide an overview of the STP for the specialisms within this theme. This is followed by the Generic, Division and Themed Learning Outcomes and Indicative Content, together with the high-level work based learning outcomes.
Section 8: Professional Practice

Professional practice spans the whole of the three-year training programme, underpinning both work based training and the MSc in Clinical Science and is described in the document Good Scientific Practice. This document sets out the principles and values on which good practice undertaken by the Healthcare Science workforce is founded. Wherever possible teaching should be contextualised to patients and patient care recognising that the work of all members of the healthcare science workforce have an impact on patients and their care.

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
Further details including the content of each domain can be found in Appendix 3.

Within the MSc Clinical Sciences (Clinical Engineering) key outcomes for trainees are for all modules are shown below.

<table>
<thead>
<tr>
<th>Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On successful completion of this module the trainee will: Adamas podia</td>
</tr>
<tr>
<td>1. Present complex ideas in both oral and written formats at a level appropriate to the hearer.</td>
</tr>
<tr>
<td>2. Consistently operate within sphere of personal competence and level of authority.</td>
</tr>
<tr>
<td>3. Manage personal workload and objectives to achieve quality of care.</td>
</tr>
<tr>
<td>4. Actively seek accurate and validated information from all available sources.</td>
</tr>
<tr>
<td>5. Select and apply appropriate analysis or assessment techniques and tools.</td>
</tr>
<tr>
<td>6. Evaluate a wide range of data to assist with judgements and decision making.</td>
</tr>
<tr>
<td>7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.</td>
</tr>
<tr>
<td>8. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration.</td>
</tr>
<tr>
<td>9. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.</td>
</tr>
</tbody>
</table>
Section 9: MSc Clinical Science (Clinical Engineering)

9.1 Overview of STP in Clinical Engineering

The diagram below provides an overview of the STP each trainee in Clinical Engineering will follow.

Figure 1: Modernising Scientific Careers: Scientist Training Programme (STP): Diagrammatic representation of employment-based, pre-registration, three-year NHS-commissioned education and training programme

9.2 Clinical Engineering Route Map

The route map overleaf shows how the high-level framework has been interpreted for the MSc in Clinical Science (Clinical Engineering) for each of the three specialisms, namely:

i. Rehabilitation Engineering
ii. Clinical Measurement and Development
iii. Device Risk Management and Governance
MSc Clinical Science Route Map for Clinical Engineering

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Specialist Clinical Engineering: underpinning knowledge for rotational work based training [40]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rehabilitation Engineering**

- Rehabilitation Engineering 1 [20]
- Rehabilitation Engineering 2 [30]
- Research Project [30]

**Clinical Measurement and Development**

- Clinical Measurement and Development 1 [20]
- Clinical Measurement and Development 2 [20]
- Research Project [30]

**Device Risk Management and Governance**

- Device Risk Management and Governance 1
- Device Risk Management and Governance 2
- Research Project [30]

**Credits**

<table>
<thead>
<tr>
<th>Division/Theme</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic</td>
<td>20</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Division/Theme</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Specialism</td>
<td>50</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
</tbody>
</table>
Section 10: Generic Modules

Generic Curriculum

The generic STP MSc Clinical Science curriculum followed by all trainees comprises three modules:

- Introduction to Healthcare Science, Professional Practice and Clinical Leadership: Year 1
- Research Methods: Year 2
- Research Project: Years 2 and 3

The generic STP work based programme generic curriculum modules are:

- Professional Practice: Years 1, 2 and 3
- Elective: following completion of the rotational training programme

These modules align to Good Scientific Practice (see Appendix).

Year 1: Generic Module
Introduction to Healthcare Science, Professional Practice and Clinical Leadership
[20 credits]

The overall aim of this introductory module is to provide all trainees with a broad knowledge and understanding of science and scientific knowledge, contextualised to the practice of healthcare science and the services provided by their healthcare science division/specialism. Central to this is the contribution of healthcare science to patient care, patient safety, service delivery, research and innovation, often at the cutting edge of science, for example genomics and bioinformatics. All members of the healthcare science workforce must understand the impact of their work on patients and patient care and remember that their work has a direct or indirect impact on patient care.

It is recognised that some of the learning within this module will not be at master’s level, as allowed for in university regulations, but achievement of each learning outcome provides the building blocks for the division- and specialism-specific learning to follow, ensuring a common starting point for all trainees. While some of the learning may be at a lower level, the application of that knowledge in the divisional and specialist modules will be at master’s level.

As an introductory module it is expected to provide an overview and reinforcement of key concepts with respect to the organisation, structure and function of the body, and important areas such as the psychosocial aspects of health and disease, clinical pharmacology and therapeutics, genomics and bioinformatics.
A major focus of this module is professional practice. This module will introduce and critically review the frameworks and academic literature underpinning professional practice and enable trainees to gain the knowledge, skills, experience and tools to develop, improve and maintain high standards of professional practice at all times.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

**Scientific Basis of Healthcare Science**

1. Describe the cellular, tissue and systems responses to disease and discuss those body systems and processes relative to your division/specialism.
2. Explain the main principles and core concepts of clinical genetics and genomics and discuss in the context of patients referred to services provided by your division/specialism.
3. Explain the main principles and core concepts of the sociology of health and illness and discuss those relevant to patients and the role of your division/specialism.
4. Explain the basis of epidemiology, public health and health protection and discuss in relation to patients and the safety of patients referred to services provided by your division/specialism.
5. Explain the basic principles of clinical pharmacology and therapeutics and discuss in relation to patients and the safety of patients referred to services provided by your division/specialism.
6. Explain the basic principles of physics that underpin healthcare science and discuss in relation to patients and the safety of patients referred to services provided by your division/specialism.
7. Discuss and justify how bioinformatics, including large biological datasets, contributes to patient safety, patient care and the practice of healthcare science and defend the governance and ethical frameworks within which bioinformatics can be used.

**Professional Practice**

8. Discuss and appraise the ethical foundations of professionalism, including critical reflection, and how these relate to the clinical scientist, the patient, the practice of healthcare science and the wider healthcare environment.
9. Explain and critically evaluate the structures, processes and methodologies that underpin the quality of the service provided by the NHS and quality improvement initiatives to promote high-quality patient care and enhance patient safety, and discuss the quality mechanisms relevant to your division/specialism.
10. Explain the principles of effective written and verbal communication and feedback, considering the needs and dignity of patients, the public, health professionals and scientists.
11. Describe and evaluate the basic principles and structures underpinning history taking, clinical examination and clinical decision making and discuss their role in your division.
Clinical Leadership
12. Discuss, compare and contrast a range of leadership models, including those that underpin current NHS Leadership and Competency Frameworks, and identify and critically evaluate how your personal values, principles and assumptions affect your personal leadership style.
13. Explain the current structure and management of health and social care systems and services at a national (UK-wide) and local level and the way in which the voice of patients and the public is embedded in all aspects of healthcare and healthcare education.

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

1. Practise the skill of history taking.
2. Practise the skill of giving and receiving meaningful feedback.

Indicative Content

Review of the organisation, structure and function of the body
- Chemical, cellular and tissue level of organisation of the body
- Metabolism
- Function of blood as a tissue, blood cells (types and life times).
- Anatomy and physiology:
  - skin
  - skeletal system
  - respiratory system
    - ventilation
    - gas exchange
    - blood gas transport
  - heart, blood vessels and lymphatic system
- Central, peripheral and autonomic nervous system
- Vision, hearing and equilibrium
- GI tract, including digestion and absorption of food, the liver and liver function tests
- Renal system
- Endocrine system
- Electrolyte and acid-base balance
- Hormonal mechanisms and control
- Abdomen, pelvis and perineum, including male and female reproductive tract

Review of pathophysiology: cellular, tissue and systems responses to disease
- Review of the pathological processes underpinning common diseases:
  - cell death
  - inflammation
  - neoplasia
  - hypertrophy
  - hyperplasia
o tissue response to injury and repair

**Introduction to the main principles and core concepts of clinical genetics and genomics**
- Meiosis and Mendelian inheritance
- Nucleic acid structure and function
- Chromosome structure and function
- Nomenclature used to describe the human genome
- Common genetic disorders
- Impact of genetic disorders on the patient and their families
- Genomic technology and role of the genome in the development and treatment of disease

**Introduction to sociology of health and illness**
- Factors affecting health and their contribution to inequalities in health between populations
- Basis of health protection, including principles of surveillance
- Patients' responses to illness and treatment, including the impact of psychological and social factors including culture, on health and health-related behaviour
- 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

**Introduction to epidemiology, public health and health protection**
- Health and disease in population terms
- The importance of population factors in individual health/disease processes
- Data interpretation, including the variability of biological data and application of statistics
- Investigating disease, epidemiology and natural history, including mathematical modelling
- Role of local, national and international bodies associated with health protection
- Principles of surveillance, the characteristics of different surveillance systems and key current policies and programmes used to protect health
- Screening programmes, including design, strengths and weaknesses

**Introduction to clinical pharmacology and therapeutics**
- Overview of the basic principles of pharmacokinetics
- Overview of the basics of drug metabolism and excretion
- Basic mechanisms and clinical importance of drug interactions

**Basic principles of physics underpinning common measurement techniques used in healthcare science**
- Structure of matter (atomic and nuclear models)
• Radiation: nature and its measurement and radiation safety
• Physics and mathematics of image formation
• Basic electricity and magnetism as it relates to the measurement of physiological signals
• Viscous and inertial flow of simple liquids

Ethical foundations of professionalism and the patient at the centre of care
• Defining professionalism within health and healthcare science
• Characteristics (personal traits) that impact on professionalism and professional practice in the workplace
• Ethical, legal and governance requirements arising from working at the level of the Clinical Scientist
• Critical Reflective Practice
  o Evidence base
  o Reflection as a structure for learning
  o Frameworks that support critical reflective practice
  o Reflection to improve professional practice
  o Reflection as a model for developing deep learning
  o Reflection as a means of improving patient care, service delivery and scientific investigation

Introduction to quality, quality improvement
• Patient safety
• Definition of terms
• Quality management
• Quality control
• Quality assurance
• Quality improvement
• Quality methodologies
• Quality processes and procedures
• Clinical governance
• Current NHS quality management and improvement systems
• Quality assurance to protect patients and assure high-quality healthcare science services, and deliver safe and effective services

Introduction to history taking, clinical examination
• Importance of patient-centred care, treating patients with respect, honesty and compassion, maintaining patient dignity and confidentiality and putting the patient first
• Duty of candour and the importance of this in healthcare
• Informed consent
  o Principles, guidance and law with respect to informed consent
  o Introduction to the patient, including role of the Clinical Scientist
  o Explanation to the patient
• Structured models for presenting a patient history
• Process of patient-centred interviewing and the features of a good consultation
  o Initiating the session
  o Gathering information
Building the relationship
Explaining and planning
Closing the session
- Link between the patient history and examination and development of clinical investigation and management plans
- Shared clinical decision making
- How information from a history and examination is used to develop clinical management plans

Introduction to communication skills
- Principles of effective communication, including:
  - written and electronic
  - verbal
  - non-verbal
- Importance of:
  - signposting
  - listening
  - paraphrasing
  - language
  - commonly used questioning techniques
  - non-verbal behaviour
  - ideas
  - beliefs
  - concerns
  - expectations
  - summarising
  - communication
- Range of question types that can be used in a communication
- Key features of effective patient interviews and information giving
- Adapting communication methods for people/groups/culture
- Feedback
  - The role of feedback in clinical education and continuing professional development
  - Feedback models
  - Characteristics of effective feedback

Introduction to leadership within the NHS
- Theories and models of leadership
- Concept of shared leadership
- Associated personal qualities and behaviours that promote shared leadership
- Overview of the NHS Leadership Framework and Clinical Leadership Competency

Introduction to the structure of the NHS
- Structure of the NHS across the four UK countries
  - Structure
  - Accountabilities
  - Funding arrangements
  - Working relationships
• NHS Constitution
  o The seven key principles that guide the NHS in all it does
  o NHS Values
    ▪ Respect and dignity
    ▪ Commitment to quality of care
    ▪ Compassion
    ▪ Improving lives
    ▪ Working together for patients
    ▪ Everyone counts
• Quality improvement structures and processes within the NHS
• Patient safety and the requirement to protect patients from avoidable harm
• Patient focus
  o Shared decision making with patients
  o Access to information
  o Choice
  o Personalised care
  o Safeguarding patients

Year 2:   Generic Module
Research Methods
[10 credits]

The overall aim of this module is to ensure that the trainee has the knowledge, skills and experience of the role of research, development and innovation in the NHS in improving patient care, including prevention, diagnostics, treatment and service delivery. On completion of this module and the research project, trainees should be able to generate ideas; assess, plan, conduct, evaluate, interpret and report research and innovation projects, which includes original research; and disseminate the findings and, where appropriate, the adoption of the findings. Trainees should also be able to use research to improve practice.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Discuss and critically evaluate the context within which research, development, innovation and audit are undertaken to improve patient care, promote innovation and improve service delivery.
2. Describe, compare and contrast a range of research methods/approaches, including cohort studies, qualitative, quantitative, systematic review, sampling techniques and clinical trials.
3. Explain and justify current UK ethical and governance frameworks and processes spanning the conduct of human and animal research, innovation and audit.
4. Critically evaluate the literature/evidence base to identify a research question and create a new approach or technique to improve patient care or service delivery.
5. Discuss and justify the research, audit and innovation process from idea generation to dissemination/implementation, including patient/user involvement and intellectual property.
6. Describe and evaluate a range of data analysis techniques to ensure the validity, reliability and appropriateness to the research aim, design and conclusion.
7. Describe how clinical guidelines are produced and the concept of evidence-based practice, including the role of current statutory and advisory regulatory bodies.
8. Identify potential sources of research and innovation funding for healthcare science/Clinical Scientists.

<table>
<thead>
<tr>
<th>Learning Outcomes: Practical Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>On successful completion of this module the trainee will:</td>
</tr>
<tr>
<td>1. Undertake an evidence-based literature review, critically appraise the output, draw appropriate conclusions and report the findings, and where appropriate, use the findings to inform a research project.</td>
</tr>
<tr>
<td>2. Identify, discuss and critically evaluate a research, innovation or audit project that has resulted in an improvement in patient care, diagnostics or service delivery.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicative Content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research methods/approaches</strong></td>
</tr>
<tr>
<td>• Differentiation between audit and research</td>
</tr>
<tr>
<td>• Cohort studies</td>
</tr>
<tr>
<td>• Qualitative</td>
</tr>
<tr>
<td>• Quantitative</td>
</tr>
<tr>
<td>• Systematic review</td>
</tr>
<tr>
<td>• Meta-analysis</td>
</tr>
<tr>
<td>• Sampling techniques</td>
</tr>
<tr>
<td>• Clinical trials (pre-clinical to translational)</td>
</tr>
<tr>
<td>• Epidemiological studies</td>
</tr>
<tr>
<td>• Study design</td>
</tr>
<tr>
<td>• Hypothesis generation and testing</td>
</tr>
<tr>
<td><strong>Ethical and governance research frameworks</strong></td>
</tr>
<tr>
<td>• Good Clinical Practice (GCP)</td>
</tr>
<tr>
<td>• Human research</td>
</tr>
<tr>
<td>• Animal research</td>
</tr>
<tr>
<td>• Innovation</td>
</tr>
<tr>
<td>• Audit</td>
</tr>
<tr>
<td><strong>Research, audit and innovation process</strong></td>
</tr>
<tr>
<td>• Literature searching and referencing</td>
</tr>
<tr>
<td>• Innovation pathway (Invention, Evaluation, Adoption and Diffusion)</td>
</tr>
<tr>
<td>• Idea generation</td>
</tr>
<tr>
<td>• Patient/user involvement</td>
</tr>
</tbody>
</table>
• Peer/expert review
• Practical and financial criteria and constraints affecting research
• Dissemination/implementation
• Intellectual property
• Quality assurance
• Monitoring and reporting
• Archiving
• Roles and responsibilities of the research/innovation team

Data analysis techniques
• Data validity, reliability and appropriateness
• Application and interpretation of statistical techniques
• Power calculations
• Intention-to-treat analyses

Clinical guidelines
• Evidence-based practice
• Statutory and advisory regulatory bodies

Research and innovation funding
• Sources of funding including research councils and charities
• Grant applications
Section 11: Division/Theme-Specific Modules

This section covers the division/theme-specific module that will be studied by all trainees undertaking the Clinical Engineering programme.

<table>
<thead>
<tr>
<th>Division:</th>
<th>Physical Sciences and Biomedical Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Clinical Engineering</td>
</tr>
<tr>
<td>Year 1:</td>
<td>Introduction to Specialist Clinical Engineering [40 credits]</td>
</tr>
</tbody>
</table>

The overall aim of this module is to provide trainees with the knowledge that underpins the first four rotations of the Clinical Engineering STP and the common learning required within the division.

A high-level description of the work placed learning is included to provide MSc Clinical Science providers with information on how the academic and MSc elements of each STP programme integrate. The full Work Based Learning Guide can be found at:


Year 1: Introduction to Specialist Medical Physics [40 credits in total]
- Clinical Measurement and ICT (CMICT)
- Design and Development (DD)
- Rehabilitation Engineering (RE)
- Device Risk Management and Governance (DRM)

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Describe the legislation that underpins safe working within the radiation, workshop and clinical environments.
2. Discuss the basis of medical electronics and the medical device life cycle.
3. Discuss the basis of rehabilitation engineering and biomechanical assessment.
4. Describe the basis of clinical measurement.
5. Discuss and evaluate the role of Clinical Engineering in innovation and service development.

Indicative Content

Information and Communication Technology

- Range of general purpose computer software in common use, including spreadsheets, flat-file and structured databases, online reference and collaborative resources
- Computing applied clinically, including the additional safeguards when ‘the computer acts as a clinical device’ and the role of the Medicine and Healthcare products Regulatory Agency (MHRA), the Food and Drugs
Administration (FDA) and the International Electrotechnical Commission (IEC) and their role in CE Marking

- Introduction to the concept of the software life cycle and the tools and frameworks used to specify, develop, validate and verify clinical software
- Basic principles relating to Information and Communication Technology (ICT) security, including firewalls, virus protection, encryption, server access and data security
- Information Governance, including NHS security policies
- Data exchange standards and be aware of some of the common standards, e.g. Digital Imaging and Communications in Medicine (DICOM) and Healthcare Level 7 (HL7)
- Networking systems in common clinical use and be aware of the relevant local trust information technology policies
- Basic principles of applicable legislation and of local policies, including the Data Protection Act, Computer Misuse Act and Freedom of Information Act

Clinical Measurement
- The physiology of pressure, flow, temperature, pH, blood gases, respiratory function and electrophysiology
- The physical principles underpinning these measurements
- Transducers for physiological measurement
- Calibration, traceability of standards
- Sources of error: random, systematic and human
- Sensitivity and specificity of measurement techniques
- Relationship of measurement results to clinical pathology, data processing and interpretation

Safety
- Health and safety legislation specific to division
- Risk assessment techniques
- Chemical safety: COSHH, hazards, storage, use and disposal
- Electrical safety: medical equipment, leakage currents, fault conditions, isolation and circuit protection; biological/physiological response to electric shock; treatment of electric shock; equipment testing
- Mechanical safety: lifting gear; guards and operation of machine and hand tools, eye and ear protection; fumes, dusts, moving and handling
- Biological safety: pathological and normal specimens; blood and other tissues; equipment contamination, cleaning, cross-contamination; handling procedures and protocols
- Theatre safety: anaesthetic agents, explosion hazard, waste gas extraction, function checks, obstacles, sterility
- Workshop safety

Innovation and Service Improvement
- Role of Medical Physics and Clinical Engineering in innovation and service improvement
- Project management
- Process mapping
- Equipment life cycle
- Specification, procurement, installation and commissioning
- Critical review of protocols, techniques and equipment
- Health Technology Assessment
- Horizon scanning

**Medical Electronics**
- Electronic components
- Basic circuit design (analogue and digital)
- Microprocessor principles
- Data acquisition techniques
- Applied signal processing
- Biopotential electrode amplifiers
- Transducers and interfaces
- Interfacing computers, principles of wired and wire-free networks
- Telemetry
- Opto-electronics
- Electromechanical systems
- Intelligent systems
- Safety/reliability analysis of designs
- Instrumentation for physiological measurement and control
- Clinical applications of medical instrumentation system, e.g. electrophysiology, defibrillation, patient monitoring, drug delivery, endoscopy, life support, the operating theatre environment

**Introduction to Rehabilitation Engineering**
- Normal development and ageing
- Basic biomechanics of the musculoskeletal system
- Biomaterials
- Communication, learning, mobility and neurological disabilities
- Measurement of gait
- Basics of ergonomics
- Disability legislation and Medical Devices Directives
- Introduction to environmental controls

**Medical Device Life Cycle**
- Health Technology Assessment
- Principles of project management
- Quality systems and standards
  - ISO9000
  - EN13485
- Equipment evaluation
- Medical device life cycle
- Medical Devices Directorate
- Risk management principles applied to medical devices

**Introduction to Radiation Physics**
- X-rays, electrons (betas), neutrons, alpha and other particles
- Radioactivity units and relationships
• X-ray production
• Physical effects of radiation
• Interaction processes with matter
• Measurement and instrumentation
• Biological effects of ionising radiation
• Basic principles of imaging:
  o X-ray, computerised tomography (CT)
  o magnetic resonance (MR)
  o nuclear medicine
  o ultrasound (US)
• Non-ionising radiations including ultraviolet (UV), radiofrequency (RF) and microwaves, lasers, infrared, magnetic fields and ultrasound
• Radiation safety: dose limits; national and international organisations and recommendations; legislation; principles of protection, safe practice, monitoring and reporting applied to:
  o ionising radiation
  o UV, microwave, RF and magnetic fields, lasers and ultrasound

Section 11.1: Rotational Work Based Modules for Clinical Engineering

This section contains the work based learning outcomes for this Scientist Training Programme, further details can be found in the accompanying Work Based Learning Guides

Clinical Measurement and ICT (CMICT)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Participate in clinical measurement procedures effectively and safely with due regard to the patient, health and safety, data security and governance in ICT within the context of Medical Physics and Clinical Engineering.
2. Apply statistical techniques to clinical measurement data and interpret the outcome of the statistical tests.
3. Manipulate data using a spreadsheet environment and an appropriate programming language.
4. Use of configuration control in relation to PC software installations and local area networks, including the installation of systems and applications.

Design and Development (DD)

Learning Outcomes: Associated Work Based Learning
High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

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

Device Risk Management and Governance (DRM)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Operate a wide range of medical devices used in the clinical environment, understanding their clinical applicability, associated risks and limitations.
2. Operate standard workshop test equipment and specialist medical device test instrumentation, including electromedical safety testers. Using appropriate equipment to test a range of Class 1 and Class 2 equipment of types B, BF and CF, including some with applied parts.
3. Carry out the following device life cycle technical tasks:
   a. identify the key elements involved in a medical device procurement exercise
   b. acceptance test and commission a new medical device
   c. design of training material to support the use of a medical device in the clinical setting
   d. perform planned maintenance on a range of medical devices
   e. describe and observe the device repair process
   f. condemn a medical device.
4. Identify sources of patient safety information and describe the key elements of processes to manage safety alerts and investigate patient incidents involving medical devices.
5. Identify and navigate the standards that underpin the organisation’s strategy for medical device management and service delivery arrangements for life cycle management, including:
   a. prevailing national standards for healthcare
   b. legal/statutory requirements
   c. electromedical safety standards
   d. quality management standards
e. risk management standards
f. best practice standards
g. organisational polices and procedures, together with medical device workshop-specific procedures.

6. Use the organisation’s medical device information system for device risk management activities, including the recording of key information relating to life-cycle service elements as well as the ability to retrieve essential asset-related information and reports.

7. Perform a risk assessment on a piece of equipment or a service-related issue, showing an appreciation of local institutional risk management policies and procedures.

Rehabilitation Engineering (RE)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

In several 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. Participate in a patient assessment relevant to the clinical placement being undertaken.
2. Assess, under supervision, biomechanics and function as part of the provision of a clinical service, including the utilisation of a range of measurement techniques.
3. Develop preliminary recommendations for intervention and rationale for each.
### Section 12: MSc Clinical Engineering specialising in Clinical Measurement and Development

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<td>Research Project in Clinical Measurement and Development</td>
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- **Generic Modules**: Common to all divisions of healthcare science
- **Division/Theme-Specific Modules**: Common to a division or theme
- **Specialist Modules**: Specific to a specialism
This module provides the trainee with the knowledge that underpins the specialist module in Clinical Measurement and Development and gives the trainee the tools to undertake work based learning.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Describe the key principles of clinical measurements, including ethical considerations and the interface between technology and humans to ensure repeatable, accurate measurements.
2. Explain and critically justify the need to apply engineering design principles to novel clinical measurement, software and electronic design solutions.
3. Work within project management methodologies.
4. Discuss the process of specifying, designing, implementing, validating and verifying a novel clinical measurement, software or electronic design solution.

### Indicative Content

**Software Engineering**

- The importance of engineering discipline in developing software
- Overview of process models and their importance
- Comparison of process models
- Structured development methods (e.g. SSADM)
- The software development cycle, including:
  - requirements
  - specification
  - design
  - implementation
    - language selection
    - software coding and coding management
    - procedural, object-oriented and functional programming
    - real-time system programming
    - embedded system programming
  - validation and verification

**Project Management**

- Risk management
- Team management (personnel and technical)
- Project planning (resource and technical)
- Education and training
• Cost estimation
• Project scheduling

**Software Quality Assurance**
• Configuration management and change control
• Software tools
• Standards
• Documentation

**Clinical Measurement**
• Detection of physiological signals and potential sources of interference
• Normal ranges and abnormal results
• Processing physiological signals
• Safety issues relating to transducers and associated equipment
• Sources of artefacts
• Stimulation and evoked response techniques
• Instrumentation and signal processing
• Measurements in organ systems, e.g. cardiovascular, respiratory, neurological, urological
• Audiological and ophthalmological measurements
• Ambulatory monitoring
• Clinical validation and verification of developed systems

**Medical Engineering Design**
• The design process, and description of the problem to be solved
• Standards and requirements
• Prototyping and testing
• Technical communication
• Project monitoring
• Outcome evaluation

**Division: Physical Sciences and Biomedical Engineering**
**Theme: Clinical Engineering**
**Specialism: Clinical Measurement and Development**

**Years 2 and 3:**
**Research Project in Clinical Measurement and Development**
[60 credits]

The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project 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 knowledge in a specialism of healthcare science. The research project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be designed to take into account the research training required by individual
trainees and the needs of the department in which the research is to be conducted.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Discuss the stages of the research and innovation process from conceptualisation to dissemination and, if appropriate, translation into practice.
2. Describe the purpose and importance of different kinds of research, including scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement and supporting professional service users, and relate these to the roles undertaken by Clinical Scientists in the trainee’s specialism.
3. Discuss and evaluate the use of reference manager systems.
4. Justify the rationale for research governance and ethical frameworks when undertaking research or innovation in the NHS.
5. Describe the process and requirements for publication in a peer-reviewed journal and the current system of grading research publications.

**Learning Outcomes: Practical Skills**

On successful completion of this module the trainee will:

1. Design, plan and undertake a research project to test a hypothesis from conception to completion/archiving in accordance with ethical and research governance regulations, drawing on expert advice where necessary and involving patients and service users.
2. Analyse the data using appropriate methods and statistical techniques, and interpret, critically discuss and draw conclusions from the data.
3. Prepare a written project that describes and critically evaluates the research project, clearly identifying the strengths and weaknesses.
4. Present a summary of the research project and outcome that conforms to the format of a typical scientific presentation at a national or international scientific meeting, responding to questions appropriately.
5. Prepare a summary of the research project suitable for non-specialist and lay audiences.

**Indicative Content**

- Critical evaluation of the literature/evidence base
- Reference management
- Identification of a research question
- Research ethics and regulatory requirements, including issues related to access and use of information
- Data protection and confidentiality guidelines
- Patient safety
- Patient consent
- Sources of funding/grants
• Peer review/expert advice
• Possible risks and balancing risk vs benefit
• Project management techniques and tools
• Roles and responsibilities of those involved in the research
• Monitoring and reporting
• Data analysis
• Data interpretation
• Criteria/metric for assessing and grading research data and publications in the scientific, NHS and HE sectors
• Range of formats and modes of presentation of data
• Requirements for publications submitted to scientific, education and similar journals
• Current conventions with respect to bibliography and referencing of information

Division: Physical Sciences and Biomedical Engineering  
Theme: Clinical Engineering  
Specialism: Clinical Measurement and Development  
Year 3: Clinical Measurement and Development 2  
[30 credits]

This module provides the trainee with the knowledge that underpins the specialist rotation in Radiation Physics in the third year of the MSc.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Develop web-based solutions in a complex networking environment.
2. Use a range of complex software techniques to solve clinical problems.
3. Discuss and evaluate the range of materials encountered in the development of novel engineering solutions in medicine.
4. Critically appraise the development of innovative design solutions in aids for daily living.

Indicative Content

Web development
• Strategies for web development, including:
  o hosting strategies
  o server/database replication, backup and archiving, RAID, bandwidth, availability
• Programming for the web with reference to current standards and programming tools, including:
  o web programming
  o forms and data
  o limiting access
  o developing dynamic content
  o interfacing with a database
• Security and privacy
  o public and private key encryption

Networking
• Local and wide area networking, including:
  o available architectures
  o performance issues
  o scalability
  o bridging vs routing
  o cabling infrastructure
  o hubs
  o traffic management

Software Techniques
• Neural networks and their applications
• Artificial intelligence and expert systems
• Image processing software
• Finite element analysis

Biomaterials
• Properties of cells, organs, tissues, tissue repair; tissue substitutes
• Biocompatibility, biotolerance, biodegradation
• Tissue integration, wear
• Tribology
• Materials for implantation: composites, polymers
• Synthetic organs
• Testing of materials, methods, standards, legislation

Assistive Technology
• Principles of patient assessment and rehabilitation plans
• Sensory impairments and their treatment
• Mobility and postural management
• Measurement of gait
• Environmental controls, aids for daily living, smart homes, workplace adaptations
• Augmentative and alternative communication
• Functional electrical stimulation
• Joints and joint movement
• Measurement of load and strain in the body
• Forces and movement in the body
• Principles of kinematics and kinetics; energy and power

Section 12.1: Rotational Work Based Modules for Clinical Measurement and Development
This section contains the work based learning outcomes for this Scientist Training Programmes, further details can be found in the accompanying Work Based Learning Guides.

| Module 1 (DD1) | The Project Life Cycle |

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STP MSc Clinical Engineering final version 3 0 for 2013-14.doc
### The Project Life Cycle (DD1)

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Manage an innovation and development project within the context of a formal project management methodology.
2. Agree the clinical need with other scientists and/or clinicians.
3. Evaluate the current state of the art and limitations of existing solutions.
4. Develop a specification of requirements.
5. Develop, critically evaluate and deliver novel solutions to clinical measurement, information and communication technology (ICT), and/or medical device requirements through the full project life cycle.

### Advanced Information and Communication Technology Skills (DD2)

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Configure ICT hardware, software and network components, applying relevant safety standards and configuration control.
2. Implement server-based applications, ensuring appropriate security, protective measures and routine housekeeping tasks.
3. Implement a novel application in the clinical environment in a controlled fashion.
4. Develop a software solution to a described problem using an appropriate high-level language.
5. Understand ICT standards applied to healthcare.

### Clinical Measurement (DD3)

**Learning Outcomes: Associated Work Based Learning**
High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Innovate and develop new clinical measurement solutions.
2. Provide scientific support to a novel or complex clinical investigation.
3. Provide reports on a novel or complex clinical measurement.
## Section 13: MSc Clinical Engineering specialising in Device Risk Management and Governance

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</table>
Division: Physical Sciences and Biomedical Engineering  
Theme: Clinical Engineering  
Specialism: Device Risk Management and Governance  
Year 2:  
Device Risk Management and Governance 1  
[20 credits]

This module provides the trainee with the knowledge that underpins the specialist module in Medical Device Risk Management and Governance in the second year of training and gives the trainee the tools to undertake work based learning.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Describe the key principles of medical equipment management, including standards and guidance.
2. Discuss asset and maintenance record keeping and analyse asset and maintenance records.
3. Work within project management methodologies.
4. Discuss the process of specifying, designing, implementing, validating and verifying a novel clinical measurement, software or electronic design solution.
5. Critically evaluate the risk management and governance framework for medical devices in healthcare.

**Indicative Content**

**Equipment Management**

- The principles of operation of common types of medical equipment, including examples of diagnostic, therapeutic and life support devices
- The benefits, limitations and risks associated with the use of these devices
- Testing, normal/abnormal readings and artefacts in common applications
- Test equipment for checking the function and calibration of medical equipment
- The performance of medical devices in relation to alternative models and relevant standards, using appropriate test equipment
- Methods of evaluating medical equipment (including pre-purchase and old) in relation to clinical requirements, risks and costs
- Calibration of diagnostic and therapeutic devices to appropriate accuracy, demonstrating traceability to national standards
- Infection risks and control procedures, sterilisation, decontamination, protective equipment

**Risk Management and Governance**

- National and international standards and guidance
- Equipment compliance with the requirements of the Medical Devices Directive (MDD)
• The requirements of the MDD and the application of these and technical standards to the safety and performance of medical equipment
• Device classifications
• Investigation of adverse incidents involving medical equipment
  o root cause analysis
  o failure mode analysis
• Statistical and risk analysis of repair and maintenance processes
• Clinical governance framework
• Current standards and compliance in the healthcare environment, including Standards for Better Health, NHS Litigation Authority

**Project Management**
• Risk management
• Team management (personnel and technical)
• Project planning (resource and technical)
• Education and training
• Cost estimation
• Project scheduling

**Clinical Measurement**
• Detection of physiological signals and potential sources of interference
• Normal ranges and abnormal results
• Processing physiological signals
• Safety issues relating to transducers and associated equipment
• Sources of artefacts
• Stimulation and evoked response techniques
• Instrumentation and signal processing
• Measurements in organ systems, e.g. cardiovascular, respiratory, neurological, urological
• Audiological and ophthalmological measurements
• Ambulatory monitoring
• Clinical validation and verification of developed systems

**Medical Engineering Design**
• The design process and description of the problem to be solved
• Standards and requirements
• Prototyping and testing
• Technical communication
• Tools and charts
• Project monitoring
• Outcome evaluation
The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project 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 knowledge in a specialism of healthcare science. The research project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be designed to take into account the research training required by individual trainees and the needs of the department in which the research is to be conducted.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Discuss the stages of the research and innovation process from conceptualisation to dissemination and, if appropriate, translation into practice.
2. Describe the purpose and importance of different kinds of research, including scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement and supporting professional service users, and relate these to the roles undertaken by Clinical Scientists in the trainee’s specialism.
3. Discuss and evaluate the use of reference manager systems.
4. Justify the rationale for research governance and ethical frameworks when undertaking research or innovation in the NHS.
5. Describe the process and requirements for publication in a peer-reviewed journal and the current system of grading research publications.

**Learning Outcomes: Practical Skills**

On successful completion of this module the trainee will:

1. Design, plan and undertake a research project to test a hypothesis from conception to completion/archiving in accordance with ethical and research governance regulations, drawing on expert advice where necessary and involving patients and service users.
2. Analyse the data using appropriate methods and statistical techniques, and interpret, critically discuss and draw conclusions from the data.
3. Prepare a written project that describes and critically evaluates the research project, clearly identifying the strengths and weaknesses.
4. Present a summary of the research project and outcome that conforms to the format of a typical scientific presentation at a national or international scientific meeting, responding to questions appropriately.
5. Prepare a summary of the research project suitable for non-specialist and lay audiences.

Indicative Content
- Critical evaluation of the literature/evidence base
- Reference management
- Identification of a research question
- Research ethics and regulatory requirements, including issues related to access and use of information
- Data protection and confidentiality guidelines
- Patient safety
- Patient consent
- Sources of funding/grants
- Peer review/expert advice
- Possible risks and balancing risk vs benefit
- Project management techniques and tools
- Roles and responsibilities of those involved in the research
- Monitoring and reporting
- Data analysis
- Data interpretation
- Criteria/metric for assessing and grading research data and publications in the scientific, NHS and HE sectors
- Range of formats and modes of presentation of data
- Requirements for publications submitted to scientific, education and similar journals
- Current conventions with respect to bibliography and referencing of information

Division: Physical Sciences and Biomedical Engineering
Theme: Clinical Engineering
Specialism: Device Risk Management and Governance
Year 3:
Device Risk Management and Governance 2
[30 credits]

This module provides the trainee with the knowledge that underpins the specialist module in Medical Device Risk Management and Governance in the third year of training.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Critically discuss the use of medical devices in a complex clinical/electrical/network environment.
2. Describe the range of materials encountered in the development of novel engineering solutions in medicine.
3. Critically appraise the legislation and guidance that ensures safe working with non-ionising radiation.
4. Discuss the issues around managing medical devices in complex clinical environments, e.g. neonatal intensive care, renal dialysis.

Indicative Content

Non-Ionising Radiation
- Sources – physical properties, interactions with matter, biological effects, measurement, applications and safety of:
  - UV
  - intense light sources
  - lasers
  - infrared
  - microwaves
  - RF
  - electric and magnetic fields
  - ultrasound
- The clinical measurements that use non-ionising radiation, for example:
  - red/infrared light to measure O₂ content in blood
  - infrared to measure microvascular circulation
  - UV to measure skin sensitivity
  - Doppler ultrasound
- Relevant guidelines, documents and standard operating procedures for safe practice with regard to the use of non-ionising radiation in the clinical environment
- Electromedical (EM) interactions between implanted devices and the MRI environment
- Safety issues and exposure limitations relevant to different patient groups
- Rationale behind safety standards

IT and Networking
- Networking and the network environment
- Connecting medical devices to the hospital network
- System management, configuration control and software release
- Interoperability, DICOM RT, HL7 and messaging standards
- Links to hospital administration systems
- Legislative framework for IT, data protection
- Regulatory standards including IEC601 and the Medical Devices Directive as applied to software
- Equipment management database systems
- Device tracking systems

Electrical Infrastructure and the Clinical Environment
- The standards for electrical infrastructure for medical devices
- Sources of EM interference, including mobile communication devices
- Device interactions in complex clinical environments
• The wireless patient environment

Specialist Clinical Environments
• Theatres
• Intensive care/high dependency
• Neonatal intensive care
• Renal dialysis, including:
  o renal anatomy, physiology and pathology
  o dialysis techniques and technology
  o monitoring performance
  o water treatment
  o psychological and social implications of renal replacement therapy

Biomaterials
• Properties of cells, organs, tissues, tissue repair; tissue substitutes
• Biocompatibility, biotolerance, biodegradation
• Tissue integration, wear
• Materials for implantation: composites, polymers
• Synthetic organs
• Testing of materials, methods, standards, legislation

Section 13.1: Rotational Work Based Modules for Device Risk Management and Governance

This section contains the work based learning outcomes for this Scientist Training Programme, further details can be found in the accompanying Work Based Learning Guides

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Medical Device Management Strategy (DRM1)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.
On successful completion of this module the trainee will:

1. Review an institution’s medical device management policy against the prevailing national standards and professional best practice.
2. Interpret and recommend application of relevant national standards relating to medical device management and assessment of risks.
3. Apply policies associated with decontamination of medical devices to daily work practice.

**Optimisation of Medical Device Effectiveness and Efficiency (DRM2)**

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Develop training material to aid technical and clinical colleagues.
2. Implement, develop and validate quality assurance regimens for a range of medical devices.
3. Advise on the minimisation of risks associated with device usage.
4. Critical appraisal of the information technology (IT) and interconnectivity issues associated with medical device installations.

**Equipment Acquisition, Acceptance Testing and Installation (DRM3)**

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Work with interdisciplinary clinical teams to understand and articulate both clinical and technical need.
2. Design and implement device evaluation material.
3. Project manage a project to evaluate and select a new medical device.
4. Manage complex medical device installations.

**Planned Maintenance and Repairs to Devices (DRM4)**

**Learning Outcomes: Associated Work Based Learning**
High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Manage the key components of the planned maintenance and repair process.
2. Develop policies and procedures, e.g. device cleaning and decontamination.
3. Apply quality management systems such as ISO 9001 to the workshop environment.
4. Interpret electromedical safety tests and resolve safety test anomalies.
5. Identify and resolve health and safety issues while working on medical devices.
6. Advise on calibration requirements.

Patient Safety (DRM5)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Manage and deal with safety alert standards within the organisation.
2. Act on notices and identify corrective actions to take.
3. Investigate incidents using root cause analysis or equivalent methodologies.
4. Advise on policy development to assist clinical governance and patient safety within the organisation.
5. Assess technical matters that could impair device efficacy.

Medical Device Information System (DRM6)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:
1. Act as expert user of the medical device system and advise the institute on the taxonomy of medical devices.
2. Use a medical device information system to do complex equipment management tasks.
3. Use a medical device information system to produce key performance indicators.

**Expertise in Medical Device Risk Management (DRM7)**

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Develop risk management strategies within the institution.
2. Articulate risk issues, their severity and the steps to mitigate them.
3. Minimise the risks associated with modifying medical devices.

**Professional Advisory Services (DRM8)**

**Learning Outcomes: Associated Work Based Learning**

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Establish and run interdisciplinary forums to promote the safe and effective use of technology, e.g. medical device advisory groups.
2. Serve as a contributing member of appropriate committees as required, e.g. equipment committees, governance or audit forums.
3. Audit medical device issues as requested.
4. Provide strategic business advice to the institution, e.g. medical device equipment replacement forecasts.
5. Assess the impact of emerging regulation or standardisation.
6. Advise on ad-hoc technical issues.
### Section 14: MSc Specialist Modules for Rehabilitation Engineering

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<td>Research Project in Rehabilitation Engineering</td>
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<td>Research Methods</td>
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<td>Research Project in Rehabilitation Engineering</td>
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<table>
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<th>Module Titles</th>
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<td>Healthcare Science, Professional Practice and Clinical Leadership integrating science and professional practice</td>
<td>Introduction to Specialist Clinical Engineering Underpinning knowledge for rotational elements and integrated professional practice</td>
<td>20</td>
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</table>

#### Module Categories:
- **Generic Modules**: Common to all divisions of healthcare science
- **Division/Theme-Specific Modules**: Common to a division or theme
- **Specialist Modules**: Specific to a specialism
This module provides the trainee with the knowledge that underpins the specialist module in Rehabilitation Engineering and gives the trainee the tools to undertake work based learning.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain the basis of human biomechanics and discuss the impact of disease on human movement and anatomy.
2. Discuss and justify the need to apply engineering design principles to rehabilitation engineering.
3. Work within project management methodologies.
4. Describe the measurement of human movement.
5. Discuss physiological measurements and evaluate how they can be used to control aids for daily living.

**Indicative Content**

**Human Biology and Biomechanics**
- Musculoskeletal system
- The nervous system and the senses as systems to drive assistive technology
- The load, strength, failure and equilibrium performance of musculoskeletal structures
- Joints and joint movement
- Measurement of load and strain in the body
- Forces and movement in the body
- Principles of kinematics and kinetics; energy and power
- Fluid systems in the body
- The nervous system and the senses
- The cardiovascular and respiratory system
- The urinary system
- Skin and superficial soft tissues
- The characteristics of patients and patient groups likely to benefit from biomechanical assessment and assistive technology solutions.

**Project Management**
- Risk management
- Team management (personnel and technical)
- Project planning (resource and technical)
• Education and training
• Cost estimation
• Project scheduling

Clinical Measurement
• Detection of physiological signals
• Normal ranges and abnormal results
• Processing physiological signals
• Safety issues relating to transducers and associated equipment
• Sources of artefacts
• Stimulation and evoked response techniques
• Instrumentation and signal processing
• Measurements in organ systems, e.g. cardiovascular, respiratory, neurological, urological
• The range of technologies available for biomechanical assessment (kinematics, kinetics, Electromyography (EMG), temporal-spatial parameters, clinical examination) and their physical and biomechanical bases.
• Audiological and ophthalmological measurements
• Ambulatory monitoring
• Clinical validation and verification of developed systems
• Principles and application of imaging techniques

Medical Engineering Design
• The design process and description of the problem to be solved
• Standards and requirements
• Prototyping and testing
• Technical communication
• Tools and charts
• Project monitoring
• Outcome evaluation

Rehabilitation Engineering
• Gait analysis and human movement
• Mobility and postural management
• Aspects and influence of disease on human motion and anatomy

Division: Physical Sciences and Biomedical Engineering
Theme: Clinical Engineering
Specialism: Rehabilitation Engineering
Years 2 and 3: Research Project in Rehabilitation Engineering [60 credits]

The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project 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 knowledge in a specialism of healthcare science. The research
project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be designed to take into account the research training required by individual trainees and the needs of the department in which the research is to be conducted.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Discuss the stages of the research and innovation process from conceptualisation to dissemination and, if appropriate, translation into practice.
2. Describe the purpose and importance of different kinds of research, including scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement and supporting professional service users, and relate these to the roles undertaken by Clinical Scientists in the trainee’s specialism.
3. Discuss and evaluate the use of reference manager systems.
4. Justify the rationale for research governance and ethical frameworks when undertaking research or innovation in the NHS.
5. Describe the process and requirements for publication in a peer-reviewed journal and the current system of grading research publications.

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

1. Design, plan and undertake a research project to test a hypothesis from conception to completion/archiving in accordance with ethical and research governance regulations, drawing on expert advice where necessary and involving patients and service users.
2. Analyse the data using appropriate methods and statistical techniques, and interpret, critically discuss and draw conclusions from the data.
3. Prepare a written project that describes and critically evaluates the research project, clearly identifying the strengths and weaknesses.
4. Present a summary of the research project and outcome that conforms to the format of a typical scientific presentation at a national or international scientific meeting, responding to questions appropriately.
5. Prepare a summary of the research project suitable for non-specialist and lay audiences.

Indicative Content
- Critical evaluation of the literature/evidence base
- Reference management
- Identification of a research question
Research ethics and regulatory requirements, including issues related to access and use of information
Data protection and confidentiality guidelines
Patient safety
Patient consent
Sources of funding/grants
Peer review/expert advice
Possible risks and balancing risk vs benefit
Project management techniques and tools
Roles and responsibilities of those involved in the research
Monitoring and reporting
Data analysis
Data interpretation
Criteria/metric for assessing and grading research data and publications in the scientific, NHS and HE sectors
Range of formats and modes of presentation of data
Requirements for publications submitted to scientific, education and similar journals
Current conventions with respect to bibliography and referencing of information

Division: Physical Sciences and Biomedical Engineering
Theme: Clinical Engineering
Specialism: Rehabilitation Engineering
Year 3:
Rehabilitation Engineering 2
[30 credits]

This module provides the trainee with the knowledge that underpins the third year specialist module in Rehabilitation Engineering and gives the trainee the tools to undertake work based learning.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Discuss and evaluate the practice of rehabilitation engineering.
2. Explain orthopaedic biomechanics and the requirements for orthopaedic implants.
3. Discuss and evaluate biomaterials encountered in rehabilitation engineering design solutions and their biocompatibility.
4. Describe and critically appraise the development of innovative design solutions in aids for daily living.

Indicative Content

Rehabilitation Engineering

- Practice of rehabilitation engineering for people with physical, sensory, communication, learning, or neurological disabilities, including:
  - principles of patient assessment and rehabilitation plans
sensory impairments and their treatment
  mobility and postural management
• Orthotic and prosthetic devices
• Mobility aids
• Seating systems
• Augmentative and alternative communication
• Environmental controls, aids for daily living, smart homes, workplace adaptations
• Sensory and neurological implants
• Functional electrical stimulation
• Advances in rehabilitation engineering, including:
  implantable and body-worn (bio)sensors
  neural stimulation
  biological cell manipulation
  nanotechnology
• Software for rehabilitation engineering
  finite element analysis
• The current social, political and legislative contexts, the service user perspective and ethical issues
• Evidence-based assistive technologies
• Innovation and design of custom aids for daily living for clients with a complex range of disabilities

Orthopaedic Biomechanics
• Effects of disease and age on the musculoskeletal system
• Engineering requirements of orthopaedic implants
• Mechanical load requirements
• Standards for production and testing
• Approaches to biocompatibility and constraints in respect of implants
• Common orthopaedic implants

Biomaterials
• Properties of cells, organs, tissues, tissue repair; tissue substitutes
• Biocompatibility, biotolerance, biodegradation
• Tribology
• Tissue integration, wear.
• Materials for implantation: composites, polymers
• Synthetic organs.
• Testing of materials, methods, standards, legislation

Section 14.1: Rotational Work Based Modules for Rehabilitation Engineering
This section contains the work based learning outcomes for this Scientist Training Programmes, further details can be found in the accompanying Work Based Learning Guides.

| Module 1 (RE1) | Assistive Technology |
Assistive Technology (RE1)

Learning Outcomes:Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

In relation to the following fields:
- aids for daily living
- electronic assistive technology (EAT)
- functional electrical stimulation (FES)
- postural management
- prosthetics and orthotics (P&O)
- wheelchairs

1. Undertake physical and functional patient assessment appropriate for an AT prescription. It is expected that the trainee will have exposure to the majority of the modalities listed above but focus specifically on between one and three.
2. Define and develop the interface between the patient and (a) the test/measurement equipment and/or (b) the prescribed AT equipment, discussing the possible adverse consequences in terms of safety, performance, comfort and aesthetic appearance.
3. Prescribe appropriate AT interventions in close collaboration with patients, carers and clinical colleagues, and measure and assess their outcome.
4. Design and modify devices appropriately to suit patients’ needs.
5. Train patients and carers in the safe and effective use of equipment provided.

Clinical Gait Analysis (RE2)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Undertake clinical interviews with patients as part of CGA.
2. Conduct physical/clinical examinations of patients.
3. Collect and process clinical gait data for a range of clinical presentations.
4. Interpret and report on the results from 1–3 above, demonstrating an understanding of the limitations of the techniques used.
5. Undertake system preparation, including calibration and quality assurance checks, as appropriate for use.

Medical Engineering Design (RE3)

Learning Outcomes: Associated Work Based Learning

High-level description of the work based learning that accompanies this academic module. Further details of the work based programme can be found in the Work Based Learning Guide, including the Clinical Experiential Learning, Competences and Applied Knowledge and Understanding.

On successful completion of this module the trainee will:

1. Bring new items of equipment, systems, facilities and protocols into service safely and effectively.
2. Specify, design, build and bring into service pieces of equipment, using formal design processes, to be used either (a) in a biomechanical or functional assessment, including validation against current clinical methods, or (b) to meet a specific clinical need for a particular clinical problem, including measurement of performance.
3. According to established standards, develop and keep up to date the associated documentation, including that relating to technical construction and risk management.
Appendix 1: Contributor List

Members of the STP MSc and Work Based Programme Physical Sciences and Biomedical Engineering: Clinical Engineering

Development of the STP curriculum for the MSc Clinical Sciences and Work Based programme for Clinical Engineering has been coordinated by the Modernising Scientific Careers team and the National School of Healthcare Science working with NHS and Higher Education colleagues. The professionals who have contributed to the development of STP Programme since 2009 include:

Richard Axell  Cambridge University Hospitals NHS Foundation Trust
Emma Bowers  Freeman Hospital, Newcastle
Paul Blackett  Lancashire Teaching Hospitals NHS Foundation Trust
Iain Chambers  The James Cook University Hospital, Middlesbrough
David Ewins  Douglas Bader Rehabilitation Centre, London
Anthony Fisher  Royal Liverpool University Hospital
Paul Ganney  University College London Hospital
Mike Hillman  Wolfson Centre, Bath
Stephen Lake  Royal Liverpool University Hospital
David Long  Oxford University Hospitals NHS Trust
Hamid Rassoulian  Nottingham University Hospitals Trust
Richard Scott  Sherwood Forest Hospitals NHS Foundation Trust
Adam Shortland  Guy’s and St Thomas’ Hospital, London
Julie Stebbins  Oxford University Hospitals NHS Trust
Dimitar Stefanov  Coventry University
Ian Swain  Salisbury District Hospital
Azzam Taktak  Royal Liverpool University Hospital
Paul White  Cambridge University Hospitals NHS Foundation Trust

Duncan Wood  Salisbury District Hospital

Professional bodies and societies were invited to review the curricula 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

The National School of Healthcare Science Themed Board reviewed the MSc Clinical Science (Clinical Engineering) Curriculum on 7 January 2013.

Modernising Scientific Careers Professional Advisor
Dr Derek Pearson
Appendix 2: Programme Amendments

This section lists the programme amendments following first publication.

**MSc Clinical Science (Clinical Engineering)**

**Amendments – May 2011**

Page 3 Section 1.1 High level MSc Framework – title change to read HIGH LEVEL FRAMEWORK MSc IN CLINICAL SCIENCE

Page 47 Appendix 1 added

The rest of the content in the curriculum is unaltered.

The refreshed version is called MSc Clinical Engineering 2010-11 v2 on the footer.

**Amendments – March 2013**

These amendments apply to trainees commencing STP in the academic year 2013/14.

1. A generic introduction to all STP MSc Clinical Science programmes has been added.
2. In order to improve the alignment to QAA level 7 the word ‘understand’ has been replaced with an appropriate verb from Bloom’s Taxonomy for the Knowledge domain.
3. The generic module Healthcare Science has been renamed ‘Introduction to Healthcare Science, Professional Practice and Clinical Leadership’.
4. The generic modules Healthcare Science (which incorporates Professional Practice) and Research Methods have been revised and updated.
5. The Research Project has been revised and all students are expected to complete a single 60-credit research project spanning Years 2 and 3, see relevant section.
6. *Good Scientific Practice* (GSP) sets out for the healthcare science 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. GSP has been added in the Appendices of each curricula and aspects of professionalism strengthened to reflect areas such as the need to ensure the shared nature of clinical decision making.
7. The learning outcomes related to ‘Personal Attitudes and Behaviours’ now appear in the Professional Practice section of this document but apply to all modules.

**Division:** Physical Sciences and Biomedical Engineering  
**Theme:** Clinical Engineering  
**Specialism:** Clinical Measurement and Development
Year 2:
Module: Clinical Measurement and Development 1
20 credits

Learning outcome inserted: ‘Describe the key principles of clinical measurements including ethical considerations and the interface between technology and humans to ensure repeatable accurate measurements’.

Learning outcome deleted: ‘Use software engineering techniques on projects in the workplace’.

Learning outcome amended: ‘Discuss the process of specifying, designing, implementing, validating and verifying a novel clinical measurement, software or electronic design solution’.

Indicative content amended: ‘Detection of physiological signals and potentials sources of interference’.

Division: Physical Sciences and Biomedical Engineering
Theme: Clinical Engineering
Specialism: Device Risk Management and Governance

Year 2:
Device Risk Management and Governance 1
[20 credits]

Learning outcomes amended:

On successful completion of this module the trainee will:

1. Describe the key principles of medical equipment management including standards and guidance.
2. Discuss asset and maintenance record keeping and be able to analyse asset and maintenance records.
3. Work within project management methodologies.
4. Discuss the process of specifying, designing, implementing, validating and verifying a novel clinical measurement, software or electronic design solution.
5. Critically evaluate the risk management and governance framework for medical devices in healthcare.

Indicative content amended: ‘Detection of physiological signals and potentials sources of interference’.

The new version is called STP MSc Clinical Engineering version 3.0 for 2013-14

For any queries regarding this change please email msc.hee@nhs.net
Appendix 3: 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 Probit

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
September 2012
Appendix 4: Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<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 be 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, i.e. 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 of improving the trainee’s performance (van de Ridder JMM, Stokking KM, McGaghie WC and ten Cate OT. What is feedback in clinical education? Medical Education 2008: 42: 189–197).</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 that is responsible for the three-year training programme and in which the training officer is based.</td>
</tr>
<tr>
<td>Job</td>
<td>A specific definition of the work activities, requirements and 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</td>
</tr>
</tbody>
</table>
Learning module | A distinct set of learning outcomes and competences that form part of a programme. Modules may be rotational, specialist, elective, or professional practice and can be combined to meet the needs of specific programmes.

Learning outcome | A high-level, outcome-based statement that describes what a trainee will be able to do at the end of the module.

Mentoring | 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).

Module aim | 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.

Module scope | 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.

National Occupational Standards | 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.

Practical skill | A cognitive, psychomotor, physical, or communicative ability that supports performance of the required role.

Programme | The package of learning, teaching assessment and quality assurance leading to an award.

Provider | An organisation that delivers required training and learning activities to specified quality assurance requirements.

Role | 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.

Specialism | A focused area of practice within a theme of healthcare science.

Trainer | A qualified individual who provides learning and development support for trainees.

Theme | A cluster of related specialisms within a division of healthcare science.

Work based learning | Learning that takes place in a real work setting and involves the application of academic learning to real
<table>
<thead>
<tr>
<th><strong>Work performance</strong></th>
<th>The requirements of satisfactory and consistent demonstration of competence in specified functions for a work role.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Workplace</strong></td>
<td>A real work setting in which the trainee can apply learning.</td>
</tr>
</tbody>
</table>