MODERNISING SCIENTIFIC CAREERS

Scientist Training Programme

MSc in CLINICAL SCIENCE
Curriculum

RECONSTRUCTIVE SCIENCES

2013/14
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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 that 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 12 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

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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 (Neurosensory 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: 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
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: 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)
• Innovation Health and Wealth, Accelerating Adoption and Diffusion in the NHS (December 2011)
• NHS Education and Training Outcomes Framework: www.dh.gov.uk/health/2012/01/forum-response/
• NHS Commissioning Board planning guidance 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 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 (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 [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 that oversees, advises and scrutinises 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 should be documented in a clear and accessible manner with accountabilities clearly allocated. The strategy should also demonstrate how the approach is

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3 Quality Assurance Agency Code of Practice.

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 (SEND) 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. 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:

- establishing a system of professional accreditation of education and training programmes for the regulation/registration of the healthcare science workforce;
- 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;
- 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);
- becoming an HPC education provider for the statutory regulation of clinical scientists;
- establishing a system for equivalence across the whole of the healthcare science workforce.

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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, they 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 (Reconstructive Sciences), key outcomes for trainees are for all modules are shown below.

### Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Present complex ideas in both oral and written formats at a level appropriate to patients, carers and other healthcare professionals.
2. Consistently operate within their sphere of personal competence and level of authority, exercising personal judgement.
3. Manage personal workload and objectives to achieve quality of care while maintaining a high standard of personal conduct and maintaining personal health.
4. Actively seek accurate and validated information from all available sources.
5. Initiate resolution of problems and exercise personal initiative.
6. Actively seek accurate and validated information from all available sources.
7. Select and apply appropriate analysis or assessment techniques and tools.
8. Evaluate a wide range of data to assist with judgements and decision making.
9. Maintain the safety of patients, carers, self and others.
10. Take restorative action within quality control/assurance requirements to address threats of performance deterioration.
11. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.
12. Keep knowledge and skills up to date.
Section 9: MSc Clinical Science (Reconstructive Science)

9.1 Overview of STP in Reconstructive Science

The diagram below provides an overview of the STP each trainee in Reconstructive Science 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 Reconstructive Science Route Map

The following route map shows how the high-level framework has been interpreted for the MSc in Clinical Science (Reconstructive Science).
MSc Clinical Sciences (Reconstructive Science)

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstructive Sciences – underpinning knowledge for rotational work based training [40]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reconstructive Sciences**


**Route Map: MSc Clinical Science (Reconstructive Science)**

Trainees begin by following the generic curriculum, which spans all divisions (blue) together with some theme-specific modules (yellow). In Year 2 of the MSc, trainees specialise (orange) in Reconstructive Sciences.

**Credits**

<table>
<thead>
<tr>
<th></th>
<th>Generic 20</th>
<th>10</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Division/Theme 40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Specialism 50</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Total 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
- Gastrointestinal 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
  - 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
  o Building the relationship
  o 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
  - The seven key principles that guide the NHS in all it does
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
- Shared decision making with patients
- Access to information
- Choice
- Personalised care
- 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.

**Learning Outcomes: Practical Skills**

On successful completion of this module the trainee will:

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.
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.

**Indicative Content**

**Research methods/approaches**
- Differentiation between audit and research
- Cohort studies
- Qualitative
- Quantitative
- Systematic review
- Meta-analysis
- Sampling techniques
- Clinical trials (pre-clinical to translational)
- Epidemiological studies
- Study design
- Hypothesis generation and testing

**Ethical and governance research frameworks**
- Good Clinical Practice (GCP)
- Human research
- Animal research
- Innovation
- Audit

**Research, audit and innovation process**
- Literature searching and referencing
- Innovation pathway (Invention, Evaluation, Adoption and Diffusion)
- Idea generation
- Patient/user involvement
- 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

Introduction to Reconstructive Science

This section covers the division/theme-specific module that will be studied by all trainees undertaking the Reconstructive Science STP.

Division: Physical Sciences and Biomedical Engineering
Theme: Reconstructive Sciences
Year 1: Introduction to Reconstructive Science
[40 credits]

The overall aim of this module is to provide trainees with the knowledge that underpins the STP work based rotational programme in Reconstructive Science.

A high-level description of the work based 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 can be found at:


Rotational Programme

Division: Physical Sciences and Biomedical Engineering
Theme: Reconstructive Science

Rotation A: Introduction to Reconstructive Science [10 credits]
Rotation B: Clinical Assessment [10 credits]
Rotation C: Biomedical Materials and Engineering [10 credits]
Rotation D: Introduction to Biomedical Prosthetics and Rehabilitation [10 credits]

Rotation A:
Introduction to Reconstructive Science
[10 credits]

This rotation will provide trainees with the knowledge and understanding of the range of services provided by Reconstructive Science, including the use of image data and reconstruction methods and their clinical application. Learning will be developed and applied in this module within the care pathway for the treatment of facial fractures, with other care pathways being considered at different stages of the STP.
Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Identify the range of patients referred to a reconstructive science service and the care pathways to which the service contributes.
2. Describe and apply knowledge of the anatomy and physiology of the head and neck to the practice of Reconstructive Science.
3. Observe pro-dissection of the head and neck and relate to CT image data.
4. Discuss the role of medical artists, forensic reconstruction and the relationship of the associated science and technology with Reconstructive Science.
5. Describe the sites, incidence and aetiology of fracture and displacement of facial fractures.
6. Describe the assessment, management and treatment of facial fractures.
7. Explain the potential routes of transmission of infectious agents in clinical practice, mechanisms for the prevention of infection, the scientific principles of decontamination and disinfection and their relevance to health and safety policies and the practice of Reconstructive Science.
8. Explain the selection, use and disinfection of impression materials used across Reconstructive Science and in particular in the treatment of facial fractures.
9. Explain the design, materials selection and use of custom-made splints for the treatment of maxillofacial trauma.
10. Critically evaluate the underlying risk, legal and ethical requirements in the manufacture of medical devices for maxillofacial trauma.

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. Identify anatomical structures in the head and neck using digital imaging (CT, MRI, X-ray).
2. Use image data and intra-oral casts of patients with oral and facial fractures and apply anatomical knowledge to identify and reconstruct oral and facial form.
3. Discuss treatment plans for patients requiring devices to support the treatment of facial fractures with healthcare colleagues and the patient as part of the multidisciplinary team, considering the outcomes, safety, comfort and dignity of patients.
4. Plan and manufacture devices for a range of patients with facial fractures.
5. Assist in the routine maintenance, calibration and quality assurance procedures on the equipment used to plan and manufacture medical devices.
6. Apply relevant legal, professional and ethical requirement guidelines of manufacturing devices used for maxillofacial trauma, e.g. the National Institute for Health and Clinical Excellence (NICE).

Indicative Content

Introduction to Reconstructive Science
- Care pathways in Reconstructive Science
  - Patient demographics and requirements of a reconstructive science service, including:
    - road traffic accidents (pedestrians, cyclists, etc.)
    - cancer
    - battlefield trauma
    - industrial injuries
    - sports injuries
    - physical violence
- Introduction to multidisciplinary care
- Evidence-based practice in Reconstructive Science
- Introduction to protection of children and vulnerable adults
- Social and demographic factors affecting incidence of oral and facial injuries
- Introduction to the management of reconstructive science services

Introduction to dental and periodontal injuries, and mandibular fractures
- Anatomy of the head and neck
- Incidence and aetiology of dental and periodontal injuries, and mandibular fractures
- X-ray appearance of normal tissue, and dental and mandibular fractures, e.g. orthopantomograms (OPG), posteroanterior (PA)
- Common sites of mandibular fractures fracture
- Displacement of mandibular fractures
- War and terrorism injuries

Planning and preparing for treatment
- Indications and contraindications
- Adherence to health and safety of patient, public, staff and self
- Basic clinical assessment of patients
- Basic principles of infection control
- Knowledge of local and national guidelines specific to procedure
- Types of splint that may be prescribed and manufactured
- Factors affecting materials selection for splints and dental impressions
- Factors affecting properties of materials used for manufacturing splints during and after manufacture (corrosion, mechanical, allergy)

Techniques of facial reconstruction
- Reconstruction of facial form after mandibular fractures
- Direct and indirect surgical techniques for reduction and fixation of maxillofacial fractures
- Surgical techniques for facial reconstruction following trauma
- Post-surgical trauma care
• Factors affecting healing of facial fractures
• Soft tissue forensic reconstruction techniques
• Scope of practice of medical artists/photographers and use of 3D imaging

In this module trainees will develop detailed learning that underpins the routine practical techniques
• Manufacture of thermoformed dental splints
• Manufacture of thermoformed soft bite guards
• Manufacture of wrought base metal arch bars for dentate patients with mandibular fractures
• Manufacture of splints for edentulous patients with mandibular fractures

Guidelines
• MHRA (guidance note 10, custom-made dental devices)

Calibration and quality assurance
• Characteristics of measuring equipment and their evaluation
• Definitions of calibration, verification and quality control
• Use of physical quality control

Infection control
• Communicable diseases and microbiological hazards
• Sterilisation and disinfection methods
• Common methods for prevention of cross-infection:
  o hand washing
  o single patient use items
  o disinfection of dental impressions and devices

Rotation B: Clinical Assessment, Investigation and Planning [10 credits]

This rotation will enable the trainee to gain a greater understanding of the role of other related diagnostic modalities, rehabilitation and therapeutic services such as radiology, psychology and pathology in the diagnosis and treatment of patients referred to Reconstructive Science. This module will give the trainee knowledge and understanding of the interpretation and clinical decision making associated with clinical assessment and investigations in the context of differential diagnosis, together with an understanding of the principles of operation, data acquisition and quality assurance of other diagnostic service modalities. The potential physical and psychological factors affecting patients will be explored and the trainee will be introduced to treatment and support mechanisms, including psychological assessment.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Describe the principles of patient-centred care that considers the physical, emotional, social, economic and spiritual needs of the person; their
response to illness; and the effect of the illness on the ability to meet self-care needs.
2. Discuss the physical and psychological factors associated with altered body image.
3. Describe the psychosocial factors associated with altered body image and the treatments and support mechanisms available for patients with facial deformities, including psychological assessment.
4. Explain and evaluate the application of diagnostic imaging (ionising and non-ionising) used to investigate patients referred to a reconstructive science service.
5. Identify clinical anatomical features and altered anatomy due to congenital, traumatic and neoplastic change.
6. Apply and extend knowledge of the head and neck anatomy to the planning and surgical treatment of facial deformities.
7. Discuss the incidence and aetiology of congenital and acquired craniofacial deformities.
8. Analyse and classify facial deformities using manual and computer-aided analysis techniques.
9. Discuss and justify the selection and validity of analogue and digital planning systems for elective surgery.
10. Describe the pathogenesis of common neoplasms and the structure, behaviour, diagnostic investigations and management of neoplasms of the head, neck and skin.
11. Describe and compare techniques for determining the physical, chemical and genetic characteristics of the tissue.
12. Describe and apply the TNM tumour staging system.
13. Discuss the potential routes of transmission of infectious agents in clinical practice, mechanisms for the prevention of infection, the scientific principles of decontamination and disinfection and their relevance to health and safety policies.

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. Obtain consent and make contemporaneous patient records from a range of patients referred to Reconstructive Science using a recognised structure and applying the principles of patient-centred care.
2. Perform a clinical examination, identifying clinical features and relating the clinical features to image data, recognising abnormalities of head neck and referring where appropriate.
3. Identify and classify common craniofacial anomalies and complete pre-surgical planning for simple procedures using clinical assessment, image analysis, 3D modelling data and dental casts.
Indicative Content

Physical and psychological factors associated with altered body image
- Psychoanalytic models of body image
- Cognitive behavioural models of body image
- Preoperative, early postoperative, rehabilitation, medium- and longer-term care
- Communication

Application of diagnostic imaging (ionising and non-ionising)
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- Surface data acquisition
- Nuclear medicine
- Positive emission tomography (PET)
- Ultrasound

Anatomy of the Face and Neck

Face and scalp
- Bones of the skull, their features and function
- Main cutaneous nerves supplying the face and scalp
- Course of the arteries that supply blood to the face and scalp
- Venous drainage of the face and scalp
- Organisation of the main groups of lymph nodes found in the head and neck
- Main muscles of facial expression, define their attachments and describe the movements they produce
- Layout of the main branches of the facial nerve on the face

The neck
- Triangles of the neck and list the layers of cervical fascia
- Motor and cutaneous components of the cervical plexus
- Gross anatomical relationships of structures within the neck, particularly thyroid gland and digestive tract
- Arteries that supply the thyroid gland

Mouth and tongue
- Main mucosal features of the tongue
- Extrinsic and intrinsic muscles of the tongue; describe the nerve supply and actions of these muscles
- Nerves that carry general sensation and taste sensation from the tongue
- Lymphatic drainage of the tongue

Physiology of the temporomandibular joint
- Anatomy, development and innervation of the joint
- Actions of the various muscles involved in the joint during both movement and at rest
- Reflex control of movements of the joint
- Physiology of the TMJ in relation to the clinical situation
Larynx and phonation
- Named parts of the laryngeal airway
- Intrinsic laryngeal musculature and the actions of these muscles in opening and closing the glottis
- Motor and sensory nerve supply and the lymphatic drainage of the larynx
- Movements of the larynx that occur during swallowing and phonation

Anatomy of swallowing
- Arrangement and subdivisions of the pharynx and their major contents, including muscles, blood supply and innervation
- The soft palate, the pharyngotympanic tube and the oropharyngeal ring of lymphoid tissue
- The stages of swallowing, including the action of the tongue

Protective reflexes of the airway and speech
- Process of swallowing food without it progressing down the airway
- Factors that affect secretion of mucus and describe how it protects the airway
- Why some patients gag during impression taking

Intracranial region
- Boundaries of the intracranial region and the contents of the three cranial fossa
- The organisation of the dura mater and the cranial cavity and identify the foramina or fissures through which these structures pass
- The main arteries and nerves that enter or leave the cranial cavity and identify foramina or fissures through which these structures pass

Cerebellum
- The organisation of the cortex nuclei within the cerebellum
- The nature and course of the afferent and efferent connection of the cerebellum

Cranial nerves
- The 12 pairs of cranial nerves
- The function of and which anatomical structures the facial and trigeminal nerves innervate
- Commonly occurring cranial nerve lesions
- Range of nerve disorders (i.e. Horner’s syndrome, trigeminal neuralgia, anosmia, herpetic infections, Bell’s palsy, hypoglossal lesions)
- Clinical management of a damaged nerve and its repair

Orbit
- Bones that make up the orbital cavity and structures that pass through the superior orbital fissure and through the optic canal
- Structure of the eyelids
- Extra-ocular muscles, their attachments, actions and innervation
- Lacrimal apparatus: lacrimal gland, nasolacrimal sac and nasolacrimal duct
- Sensory and motor limbs of the blink reflex
External and middle ear
- Main contents of the middle ear cavity
- Appearance of the tympanic membrane
- Motor and sensory pathways that travel in the facial nerve

Nasal and paranasal sinuses
- Relationship of the anatomy of the lateral wall of the nose to the paranasal sinuses and nasolacrimal duct
- The function of the nasal and paranasal sinuses
- The important neighbouring structures that may be involved with the spread of sinus disease
- The blood supply of the nose
- Incidence and aetiology of congenital and acquired craniofacial deformities
- Analysis and classification of facial deformities using manual and computer-aided analysis techniques.
- Analogue and digital planning systems for elective surgery
- Pathogenesis of common neoplasms
- Structure, behaviour, diagnostic investigations and management of neoplasms of the head, neck and skin.
- Methods used in a pathology department to prepare tissue samples for examination
  - frozen sections
  - paraffin-embedded (permanent) sections
- Techniques for determining the physical, chemical and genetic characteristics of the tissue
- TNM (Tumour, Node, Metastasis) tumour staging system
- Potential routes of transmission of infectious agents in clinical practice
- Mechanisms for the prevention of infection

Scientific principles of decontamination and disinfection/infection control
- Communicable diseases and microbiological hazards
- Sterilisation and disinfection methods
- Common methods for prevention of cross-infection:
  - hand washing
  - single patient use items
  - disinfection of dental impressions and devices

Rotation C:
Biomedical Materials and Engineering
[10 credits]

This rotation will provide trainees with the knowledge and understanding of the scope of practice of biomedical engineering, radiotherapy oncology modalities, and the development of effective interface techniques to enhance patient care. The study of the principles of materials science and the introduction to new and innovative materials and tissue engineering will provide the trainees with the skills to develop evidence-based analytical skills in a rapidly changing area. The interaction with therapeutic radiography is key in the students’ understanding of other treatment modalities for neoplastic disease and the factors affecting device manufacture and use in this area.
Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Describe the scientific principles underpinning the use of materials and biomaterials and critically evaluate their limitations and selection.
2. Discuss the composition, structure, processing and behaviour of metallic, polymeric and ceramic biomedical materials and their use in Reconstructive Science.
3. Discuss and evaluate the properties of silicone elastomers and their use in Reconstructive Science.
4. Describe the principles of tissue engineering and the application and their use in Reconstructive Science.
5. Discuss the role of rehabilitation engineering, medical, prosthetics and orthotics in the treatment of patients and the relationship with Reconstructive Science.
6. Describe the radiobiological basis and principles of radiotherapy, the effects of radiotherapy on tissues, treatment planning and simulation.
7. Explain the patient pathway in radiotherapy and the associated risks.
8. Discuss the physics of radiotherapy treatment machines and dosimetry equipment.
9. Describe the devices (e.g. body moulds, head masks) used to maximise treatment of the cancer cells while minimising damage to normal cells.
10. Describe and evaluate the role of quality assurance in the maintenance of equipment used in the manufacture of medical devices.
11. Critically evaluate the underlying risks, legal and ethical requirements in the manufacture and use of medical devices.

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. Select, justify, use and evaluate a range of biomedical materials in the manufacture of a variety of custom-made medical devices.
2. Design and manufacture devices to support radiotherapy in accordance with appropriate quality systems and work safely in radiation areas.

Indicative Content

Colour
- Colour science: colour and methods of colour measurement
- Principles and techniques used in shade taking and colour matching in Reconstructive Science
- Methods of skin colour reproduction
• Effects of surface finish on colour perception
• Effects of light source on colour measurement
• Skin pigmentation, racial variation, changes in skin colour due to physiological responses

Silicone polymers
• Silicone polymer chemistry: introduction to synthesis of silicone polymers and routes for cross-linking, including condensation and addition mechanisms
• Deformation of silicone elastomers, definition of resilience, modulus of resilience
• Silicone elastomers for use as resilient liners, requirements, systems, advantages and limitations
• Silicone elastomers as impression materials, requirements, systems, assessment

Tissue response to biomaterials
• Biocompatibility; soft and hard tissue response to biomaterials; hypersensitisation; blood–material interactions

Microbial interactions
• Microbial adhesion and biofilm formation, locations, incidence of device-related infection, consequences, diagnosis and control strategies
• Typical microorganisms associated with device-related infections

Degradation of materials in the biological environment
• Characteristics of the biological environment, factors leading to deterioration of materials
• Corrosion mechanisms for metallic materials: corrosion in aqueous solutions, effect of mechanical factors, approaches to corrosion control
• Degradation of polymeric and composite materials

Alloys
• Austenitic stainless steels, unalloyed titanium
• Titanium alloys: constitution, structure and properties, influence of processing on properties
• Examples of alloy selection for dental applications

Quality management systems
• Background to quality management systems
• Quality management principles applied to quality management system standards
• The ISO 9000 series of standards
• Interpretation of quality management system standards: examples of generic standards and standards for organisations associated with medical devices

Product liability
• Introduction to product liability legislation, UK and European remedies
• European law, types of EU law, new approach standards
Introduction to clinical engineering
- Role of medical physics and clinical engineering
- Basis of medical electronics and the medical device life cycle
- Basis of rehabilitation engineering and biomechanical assessment
- Basis of clinical measurement

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
- Basic principles of imaging
- X-ray, CT, MR, nuclear medicine, ultrasound
- Non-ionising radiations, including ultraviolet (UV), radiofrequency (RF) and microwaves, lasers, infrared, magnetic fields and ultrasound
- Radiation safety: dose limits. principles of protection, safe practice
- Ionising radiation, UV, microwave, RF and ultrasound

Effects of irradiation on tissues
- Biological effects of ionising radiation
- Mechanisms and effects of irradiation damage of tissues, with emphasis on the head and neck
- Types of malignant lesions for which radiotherapy is likely to be effective
- Lesions for which radiotherapy is indicated and those for which it is inappropriate
- Practical procedures involved in radiotherapy appropriate for explanation to patients

Custom-made devices in radiotherapy
- Historical device design and provision
- Intra-oral applicators, screens
- Design of radiotherapy masks
- Vacuum-forming techniques and materials
- Impression and body scanning techniques

Rotation D:
Introduction to Biomedical Prosthetics and Rehabilitation
[10 credits]

This rotation will introduce the trainee to the role of a maxillofacial prosthetist in caring for patients requiring prosthetic reconstruction and rehabilitation, the range of prostheses that can be prescribed and manufactured, and demonstrate the understanding in the provision of a prosthesis for a patient.

Learning Outcomes: Knowledge and Understanding
On successful completion of this module the trainee will

1. Outline innovative digital imaging and manufacturing technologies in relation to device manufacture.
2. Explain how anatomical knowledge is applied to the planning and design of prostheses.
3. Describe the role of maxillofacial prosthetists and technologists and other colleagues and teams in the care pathways of patients referred for prosthetic rehabilitation.
4. Analyse and criticise design factors for basic facial prostheses.
5. Discuss the range of impression materials, techniques and the factors affecting the clinical choice in the treatment of patients requiring facial/body prostheses.
6. Describe, critically evaluate and undertake the manufacturing procedure for simple ocular, nasal, auricular and nipple prostheses.
7. Explain the usage, design principles and constructional techniques of palatal obturators.
8. Describe impression techniques used for maxillary defects.
10. Explain the potential routes of transmission of infectious agents in clinical practice, mechanisms for the prevention of infection, the scientific principles of decontamination and disinfection and their relevance to health and safety policies.
11. Know current UK legislation applicable to maxillofacial prosthetics and technology.
12. Evaluate the underlying risk, legal and ethical requirements in the manufacture prosthetic devices.

Associated Work Based Learning Outcomes

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. Use a range of imaging modalities, computer modelling and physical examination to recognise both normal and impaired facial anatomy.
2. Identify treatment options for patients requiring facial prostheses referred to a reconstructive science service.
3. Develop skills in the manufacture a range of facial and body prostheses.
4. Assist in the assessment of patients referred from the breast surgery unit and production of a nipple areola complex prosthesis following post-mastectomy reconstruction.
5. Plan and manufacture dentures and palatal obturators for edentulous (without teeth) patients.

Indicative Content
Introduction to prosthetic rehabilitation
- Anatomy of the head and neck
- Ocular anatomy
- Anatomy of the breast
- Reconstructive techniques post mastectomy

Planning and preparing for treatment
- Indications and contraindications
- Adherence to health and safety of patient, public, staff and self
- Basic clinical assessment of patients
- Awareness of psychological effects of cancer, facial disfigurement and body image, and introduction to psychological support these patients
- Monitoring of patients during treatment
- The requirements for accurate patient data
- Patient confidentiality and the Data Protection Act
- Principles of the clinical management of facial prosthetic patients, patient rights, managing patients with disabilities
- Impression technique and materials for nipple prostheses
- Principles of treatment planning
- Sculptured anatomical form to match patients missing anatomical facial/body parts (i.e. ocular, auricular, nasal and nipple prostheses)
- Iris and sclera reproduction
- Colour science and skin colour reproduction
- Introduction to silicone elastomers
- Processing prostheses

In this module trainees will develop detailed learning that underpins the routine practical techniques
- Construction of adhesive-retained auricular prosthesis
- Construction of adhesive-retained nasal prosthesis
- Construction of nipple prosthesis
- Construction of ocular prosthesis

Guidelines
- MHRA (guidance note 9, custom-made medical devices)

Calibration and quality assurance
- Characteristics of measuring equipment and their evaluation
- Definitions of calibration, verification and quality control
- Use of physical quality control

Infection control
- Communicable diseases and microbiological hazards
- Sterilisation and disinfection methods
- Common methods for prevention of cross-infection:
  - hand washing
  - single patient use items
  - disinfection of dental impressions and devices
## Section 12: MSc Clinical Science – Reconstructive Science

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**Legend:**
- **Blue**: Generic Modules: Common to all divisions of healthcare science
- **Yellow**: Division/Theme-Specific Modules: Common to a division or theme
- **Orange**: Specialist Modules: Specific to a specialism
MSc Year 2 Specialist Practice

These modules provide the trainee with the knowledge and understanding that underpins and is applied to the specialist work based learning programme.

**Division:** Physical Sciences and Biomedical Engineering  
**Theme:** Reconstructive Science  
**Specialism:** Reconstructive Science  
**Module:** Medical Devices for Maxillofacial Trauma and Craniofacial Deformities  
**Year 2:** [20 credits]

This module will enable trainees to gain the knowledge and understanding that will be applied as they develop their specialist practice. They will continue to learn and gain new work based skills to enable them to competently perform a range of treatments, interact with patients, and demonstrate safe, patient centred practice. Trainees will be expected to build on the competence gained during rotational training developing technical expertise in planning, interpreting and communicating the design and manufacture of dental and medical devices and surgical plans.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

**Material Science**
1. Describe the scientific principles underpinning the use of materials and biomaterials and discuss their limitations and selection.
2. Relate the composition, structure, processing and behaviour of metallic, polymeric and ceramic biomedical materials to the design and manufacture of medical devices.
3. Analyse the possible reasons for failure and breakdown of implants and actions that can be taken to reduce this risk.
4. Evaluate the underlying risk, legal and ethical requirements in the manufacture of medical devices.
5. Apply theoretical principles of materials properties and performance in the design and manufacture of medical devices.
6. Analyse and manipulate digital data associated with the design of alloplastic implants (non-biologic material such as metal, ceramic and plastic).
7. Select and apply appropriate materials and techniques to create 3D analogues of human tissues for the study and manufacture of medical devices.
8. Discuss the principles of tissue engineering as an alternative to alloplastic implants.
9. Discuss the risk management and governance framework for prototype medical devices in healthcare.
10. Critically analyse new developments and scientific advances in biomedical materials, manufacturing techniques and clinical performance, and discuss their application for new and innovative treatments.
Clinical Assessment and Investigation
11. Discuss physical and psychological factors associated with altered body image of patients with congenital facial deformities.
12. Explain the potential routes of transmission of infectious agents in clinical practice, mechanisms for the prevention of infection, the scientific principles of decontamination and disinfection and their relevance to health and safety policies.
13. Compare and contrast the range of physical and psychological responses to illness exhibited by patients and their families in response to maxillofacial trauma and/or craniofacial deformities and the treatments and support mechanisms available.
14. Discuss and evaluate the role of members of the multidisciplinary team involved in the treatment and rehabilitation of patients with head and neck cancer and soft tissue injuries, including speech therapy, dentistry, clinical psychology and self-help/charities, etc.

Maxillofacial Trauma and Craniofacial Deformities
15. Describe the epidemiology, causes, incidence, classification and preventative strategies with respect to fractures of the maxilla and middle third of the facial skeleton.
16. Discuss the factors influencing clinical decisions with respect to treatment and rehabilitation following a range of typical dental or facial fractures.
17. Describe congenital deformities/absence of the ear and their reconstruction surgically and prosthetically.
18. Explain and justify the selection of a treatment plan for a range of patients requiring auricular (ear) prostheses based on the patient assessment and diagnosis.
19. Discuss the use of implant retention for patients with congenital absence of pinna (ear) and the use of external and bone-anchored hearing aids.
20. Discuss the factors affecting clinical decisions in the treatment of orthognathic (jaw) and craniofacial surgery.
21. Integrate the recognition and aetiology of congenital and acquired craniofacial deformities and analyse skeletal and dental deformities using manual and computer-aided analysis techniques, and evaluate and apply planning systems for orthognathic surgery.

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:

Clinical Assessment
1. Observe informed consent and assist in planning the treatment of the patient who has experienced maxillofacial trauma in accordance with
local/professional guidelines, adapting techniques as necessary to reflect possible outcomes and influencing factors.

2. Observe informed consent and assist in clinical assessment of a patient who has a craniofacial deformity in accordance with local/professional guidelines, adapting techniques as necessary to reflect possible outcomes and influencing factors.

3. Record a comprehensive and contemporaneous patient history recognising the significance of changes in the patient’s reported health status and taking appropriate action.

4. Write a treatment plan for patients who have experienced maxillofacial trauma or have a craniofacial deformities in partnership with the patient, supporting the patient to manage their fear and anxiety, and referring to other support services for advice or alternative/adjunct treatment where appropriate.

5. Discuss and agree treatment plans for a range of patients referred to the unit with maxillofacial trauma or craniofacial deformities with clinical colleagues, the patient and, if appropriate, relatives or carers.

Maxillofacial Trauma
6. Plan, design, manufacture and evaluate dental devices for patients with fractures involving the mandible, maxilla and middle third of the facial skeleton.

Craniofacial Deformities
7. Discuss treatment options, design, plan, manufacture, fit and evaluate a range of auricular (ear) prostheses for patients with congenital absence of pinna (external part of the ear) prosthesis with the patient, their carers or relatives, and colleagues, as appropriate.

8. Discuss treatment options and plans with patients, their carers or relatives, and colleagues for bimaxillary orthognathic (jaw) surgery and generate pre-surgical plan.

9. Manipulate, analyse and interpret 3D digital imaging data of the head and neck for patients requiring orthognathic surgery.

10. Manufacture medical implants for patients requiring surgical repair.

Equipment Management
11. Assist in the routine maintenance, calibration and quality assurance procedures on the equipment used to plan and make medical devices.

Indicative Content

Deep-buried implants
- Physiological and immunological responses to alloplastic implants
- Cellular response to implants, systemic effects of implants
- Blood compatibility, non-thrombogenic surfaces
- Testing of carcinogenicity, risk assessment

Metallic implant materials
- Titanium and titanium-based alloys
- Types and composition
- Structure and properties
- Implant manufacture with titanium and titanium-based alloys

Ceramic implant materials

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• Calcium phosphate, structure, properties of hydroxyapatite, manufacturing of hydroxyapatite

Polymeric implant materials
• Polymeric implant materials, rubbers
• Deterioration of polymers, chemical effects, sterilisation effects, mechano-chemical effects, in vivo environmental effects, stability and toxicity

Failure of materials
• Behaviour of materials when stressed
• Different ways in which materials can fail (wear, fatigue, degradation by corrosion)
• Corrosion of metallic implants
• Electrochemical aspects
• Pourbaix diagrams in corrosion
• Rates of corrosion and polarisation curves
• Corrosion of available metals
• Minimisation of corrosion
• Relationship of failure to the macro- and microstructure of a material
• Role of defects in metals and the effect on an appliance

Soft tissue replacement
• Percutaneous devices
• Maxillofacial implants
• Ear and eye implants
• Space-filling implants

New developments in biomedical materials and manufacturing
• Surface coatings of implant materials, e.g. plasma coatings, hydroxyapatite coatings
• Physical and vapour deposition of thin films
• Evaluation of chemical and mechanical properties of new materials and their application
• Principles of tissue engineering, stem cell research and its application to hard and soft tissue reconstruction
• 3D printing of substrate structures, materials for scaffolds
• Hard tissue growth, soft tissue growth
• Comparisons with alloplastic materials and manufacture
• 3D printing of metallic implants, laser sintering

Fixation
• Interface problems, bone cement, porous ingrowth, direct bonding, interface and passive fixation
• Effects of fixation on implant function

Patient selection and management
• The implant patient: aetiology and assessment of condition
• Medicolegal implications of implantable prostheses; EU, US and UK legislation for implantable prostheses
• Sterilisation techniques
• Effects of sterilisation techniques on physical and chemical properties of implants
• Microbial contamination
• Effects of contamination
• Manufacturing techniques of custom-made alloplastic implants
• Effects of manufacturing techniques on the properties of implants
• Calculation of physical dimensions of alloplastic implants relating to mechanical and chemical properties of the material selected
• Effect of bone density on fixation design

3D data
• Different modalities of obtaining digital data (CT, MRI, surface data acquisition) and new developments in imaging
• 3D volumetric and 3D surface data acquisition
• Comparative analysis of methods of obtaining 3D data and accuracy
• Identification of principle anatomical structures on X-rays, CT, MRI and surface data scans
• Principles of image-guided surgery and its applications in maxillofacial and craniofacial surgery
• Dicom data, conversion to 3D data and 3D images
• Anatomical landmarks and artefacts for the different methods of data collection
• Accuracy of 3D reconstructed images
• 3D dimensional software programs available for pre-operative planning and image manipulation and assessment in pre/postoperative outcomes
• 3D software systems to predict ideal implant locations (i.e. Simplant)
• 3D templates to locate implants at surgery

Anatomical models
• Anatomical models from 3D data (i.e. CNC milling – computerised numerical controlled, rapid prototyping techniques)
• Manufacture and accuracy of 3D models used to create facial prostheses, cranioplasties and templates

Trauma
• Fracture sites of the facial skeleton
• Displacement of fractures
• Principles of treatment
• Laboratory-constructed fracture fixation devices
• Soft tissue injuries, treatments and devices
• Principles of management and technology for maxillofacial trauma
• Sports injuries and prevention
• The management and technical support for soft tissue injuries
• Post-traumatic rehabilitation
• Analysis of bone density, effect of age, bone density and mechanical properties of bone
• Mouth protectors
• Dental trauma, displacement injuries, splinting of traumatised teeth, trauma devices, arch bars (nickel silver, chrome cobalt, stainless steel), cast splints
• Metal-joining techniques
Orthognathic surgery planning
- Craniofacial and jaw deformities
  - Cleft lip and palate: incidence, aetiology, treatment
  - Surgical techniques for orthognathic surgery
  - Distraction osteogenesis
- Model-based pre-operative planning systems, computer-aided planning systems
- Design principles for devices and surgical aids for orthognathic surgery

Surgical procedures and devices
- Theatre protocols
- Surgical procedures relevant to orthognathic and craniofacial surgery

Anaplastology
- Principles of the clinical management of auricular prostheses:
  - Pre-treatment assessment
  - Treatment planning
  - Pre-prosthetic surgery
- Principles of auricular prosthesis design
- Implant retention for auricular prostheses, materials selection for one-piece stud/implant-retained prostheses
- Integration of colour technology, material and colour stability
- Impression techniques and materials

Medical legal aspects
- Medical legal aspects of treating patients, patients’ complaints procedures, carers
- Personal Protective Equipment regulations
- Medical history and records, patient and professional communication
- Medical ethics
- Informed choice/consent/negligence and maxillofacial prosthetics practice

Risk management and governance
- National and international standards and guidance
- 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 devices
- Device classifications
- Clinical Governance framework
- Current standards and compliance in the healthcare environment, including Standards for Better Health, NHS Litigation Authority
- Management of innovation and prototypes

Patient management
- Patient evaluation and referrals
- Management of patient’s fears/anxiety
- Theories of health-related behaviour and effects of drugs, allergies and lifestyle factors on patient health and rehabilitation
- Common psychosocial disorders associated with congenital facial deformities (abnormal psychology, anxiety, depression, psychoses)
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 in respect of bibliography and referencing of information
This module will enable trainees to perform a range of treatments, interact with patients, and demonstrate safe, patient-centred practice. Trainees will be expected to build on the competence gained during rotational training developing technical expertise in planning, interpreting and communicating the design and manufacture of dental and medical devices and surgical plans. They will consolidate skills in explaining procedures to patients and gaining informed consent, enhancing and extending practical skills in undertaking maxillofacial prosthetics, and it will give the trainee the tools to undertake case-based learning in the workplace.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

**Material Science**
1. Apply theoretical principles of materials’ properties and performance in the design and manufacture of medical devices for head and neck cancer and soft tissue injuries.
2. Evaluate the underlying risk, including the legal and ethical requirements in the manufacture of medical devices, including those used in the prosthetic rehabilitation for head and neck cancer and soft tissue injuries.
3. Critically analyse new developments and scientific advances in biomedical materials, manufacturing techniques and clinical performance, and discuss their application for new and innovative treatments.

**Clinical Assessment and Investigation**
4. Explain the use of quality of life measures/outcomes in the treatment and rehabilitation of head and neck cancer, including the underpinning evidence base.
5. Explain the potential routes of transmission of infectious agents in clinical practice, mechanisms for the prevention of infection, the scientific principles of decontamination and disinfection and their relevance to health and safety in a clinical setting.
6. Compare and contrast the range of physical and psychological responses to illness exhibited by patients with head and neck cancer and soft tissue injuries, and the treatments and support mechanisms available.
7. Discuss and evaluate the role of members of the multidisciplinary team involved in the treatment and rehabilitation of patients with head and neck cancer and soft tissue injuries, including speech therapy, dentistry, clinical psychology and self-help/charities, etc.

**Prosthetic Rehabilitation for Head and Neck Cancer**
8. Explain the epidemiology, pathogenesis and prevention of head and neck cancer.
9. Explain the structure, behaviour, diagnostic investigations and management of swellings in the head and neck.
10. Describe the surgical procedures relevant to the excision of neoplasms and the provision of prostheses (i.e. resection skin grafts, bone grafts, tissue expansion and flaps).
11. Describe the use, design principles and constructional techniques of obturators and appliances used in the peri-operative, intermediate and definitive rehabilitation stages of treatment.
12. Discuss and evaluate the use of radiotherapy in the treatment of head and neck cancer and the effects of radiotherapy on patients, including the patient perspective.
13. Discuss the principles underpinning the manufacture of radiation applicators and shields and other devices used in radiotherapy treatment.
14. Analyse and manipulate digital data associated with the design and manufacture of facial prostheses.
15. Select and apply appropriate materials and techniques to create anatomical models.
16. Select and justify treatment plans for the provision of ocular, facial and other external prostheses for patients with head and neck cancer, based on the patient assessment and diagnosis.

**Prosthetic Rehabilitation for Soft Tissue Injuries**
17. Discuss the process of scar formation, including hypertrophic and keloid scars following chemical and thermal injuries.
18. Discuss the incidence and aetiology, appearance and classification of chemical and thermal injuries of the skin.
19. Discuss and evaluate the evidence-based underpinning the clinical treatment of burn and other thermal skin injuries.
20. Discuss and critically evaluate the treatment of hypertrophic and keloid scars and the effect of pressure on scar formation.
21. Discuss the range of devices and materials that can be used in the treatment of hypertrophic and keloid scars.

**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:

**Clinical Assessment**
1. Observe informed consent and assist in planning the treatment of the patient who has experienced maxillofacial trauma in accordance with local/professional guidelines, adapting techniques as necessary to reflect possible outcomes and influencing factors.
2. Observe informed consent and assist in clinical assessment of a patient who has a craniofacial deformity in accordance with local/professional guidelines,
adapting techniques as necessary to reflect possible outcomes and influencing factors.

3. Record a comprehensive and contemporaneous patient history, recognising the significance of changes in the patient’s reported health status and taking appropriate action.

4. Write a treatment plan for patients who have experienced maxillofacial trauma or have a craniofacial deformities in partnership with the patient, supporting the patient to manage their fear and anxiety, and referring to other support services for advice or alternative/adjunct treatment where appropriate.

5. Discuss and agree treatment plans for a range of patients referred to the unit with maxillofacial trauma or craniofacial deformities with clinical colleagues, the patient and, if appropriate, relatives or carers.

**Maxillofacial Trauma**

6. Plan, design, manufacture and evaluate dental devices for patients with fractures involving the mandible, maxilla and middle third of the facial skeleton.

**Craniofacial Deformities**

7. Discuss treatment options, design, plan, manufacture, fit and evaluate a range of auricular (ear) prostheses for patients with congenital absence of pinna (external part of the ear) prosthesis with the patient, their carers or relatives, and colleagues as appropriate.

8. Discuss treatment options and plans with patients, their carers or relatives, and colleagues for bimaxillary orthognathic (jaw) surgery and generate a pre-surgical plan.

9. Manipulate, analyse and interpret 3D digital imaging data of the head and neck, for patients requiring orthognathic surgery.

10. Manufacture medical implants for patients requiring surgical repair.

**Equipment Management**

11. Assist in the routine maintenance, calibration and quality assurance procedures on the equipment used to plan and make medical devices.

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### Indicative Content

**Methods of obtaining 3D data**

- Methodology of the different modalities of obtaining digital data (CT, MRI, surface data acquisition) and new developments in imaging
- 3D volumetric and 3D surface data acquisition and methods of obtaining 3D data
- Identification of principle anatomical structures on X-rays, CT, MRI and surface data scans

**Dimensional data**

- Dicom data, conversion to a 3D data and 3D images
- Anatomical landmarks and artefacts for the different methods of data collection
- Accuracy of 3D reconstructed images
- 3D software programs for pre-operative planning, image manipulation and assessment in pre/postoperative outcomes
- 3D software systems to predict ideal implant locations (i.e. Simplant)
- New developments in digital analysis

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Anatomical models
- Anatomical models from 3D data (i.e. CNC milling, rapid prototyping techniques)
- Manufacture and accuracy of 3D models used to create facial prostheses and templates

Dynamic splint therapies
- Anatomy and pathology in relation to the skin and thermal injury
- Patient protocols, management of the burns patient, scar review and scar indexing
- Keloid scar formation
- Keloid treatment strategies
- Post-burn trauma therapy aetiology and assessment of condition
- Histopathology in relation to pressure splinting
- Impression techniques with and without anaesthetics
- Cranio/Maxillofacial appliances, neck splints, microstomia appliances and hand splints
- Keloid splinting

Surgical procedures and devices
- Theatre protocols
  - Information required for different surgical procedures (CT scans, models, etc.)
  - Different surgical procedures relevant to the provision of prostheses (i.e. skin grafts, bone grafts, tissue expansion, flaps and resection)
- Principles of soft tissue surgery and plastic surgery
- Principles of tissue transfer and graft support appliances
- Design principles and service requirements of surgical splints for dentate and edentulous patients
- Evaluation of laboratory-constructed surgical splints
- Comparative treatments, evaluation of splint appliances
- Design principles of appliances used in tissue transfer
- Intermediate obturator prostheses

Effects of irradiation on tissues
- Mechanisms and effects of irradiation damage of tissues, with emphasis on the head and neck
- Types of malignant lesions for which radiotherapy is likely to be effective
- Lesions for which radiotherapy is indicated and those for which it is inappropriate
- Effects of irradiation of relevance to the craniofacial team
- Radiation applicators and shields

Dentures and obturation
- Surgical splint design principles
- Intermediate obturator prostheses
- Legal, ethical, professional and technical issues associated with the provision of dentures and obturators
• Classification of post-surgical defects, effect of defect on prosthodontic design principles
• Managing restricted opening
• Materials and techniques used in obturator construction
• Design features of obturator prostheses
• Open box, hollow box, glove obturators, obturator retention and soft palate obturation
• Surface finish of prostheses and microbial colonisation and degradation of silicone elastomers
• Intermediate obturator prostheses
• Definitive obturator prostheses for partially dentate patients
• Occlusion in relation to complete and partial prosthodontics for maxillary defects
• Alternative denture retention units
• Two-part bolt, split post and tube, hinged sectional and swing lock designs
• Use of implants and precision attachments
• Criteria for clinical presentation and patient use
• Occlusal schemes for patient requiring:
  o complete dentures and obturators
  o neutrocentric
  o monoplane
  o linguised occlusion
  o balancing ramps
  o Gerber based
• Two part dentures, design criteria for patients with microstomia

Ocular prosthetics
• The ocular prosthetic patient: aetiology and assessment of condition
• Intra-orbital implant consideration assessment
• Ocular socket microbiology
  o Recognition and pathology of diseases of the ocular socket and globe
  o Surgical techniques associated with indwelling ocular prostheses
• Impression materials selection
  o Ocular impression techniques
  o Impression techniques for haptic lenses
  o Interpretation of the ocular impression
  o Modification of the ocular impression
• Modification of prosthesis patterns
• Ocular colouration, iris structure
• Colour assessment and matching, iris painting techniques
• Ocular reaction to materials
• Patient review
  o Recognition of conditions and diseases associated with indwelling ocular prostheses
  o Cleaning and surface analysis of prostheses

Anaplastology
• Principles of the clinical management of facial prostheses, pre-treatment assessment, treatment planning, pre-prosthetic surgery
• Principles of facial prosthesis design
• Impression techniques for facial and body prostheses, impression materials
• Patient management during impression procedures
• Surface scanning, rapid prototyping of analogues and prostheses, new developments in surface scanning, analysis and 3D printing
• Facial prosthetic materials, properties, biocompatibility, colouration
• Methods of skin tone simulation
• Retention and methods of support of facial prostheses
• Introduction to multipart prostheses
• Anatomical accuracy, topography and surface effects
• Colour technology, material and colour stability in prosthetic materials
• Relevant polymeric and silicone chemistry, lamination, tissue adhesives and relevant skin preparations
• Nipple prostheses, digit prostheses

**Bonding of silicone to acrylic**
• Primers and rationale for use and selection
• Substrate/primer/silicone interface, mechanical and chemical factors

**Medical legal aspects**
• Medical legal aspects of treating patients, patients’ complaints procedures, and carers
• Medical Devices Directive
• Personal Protective Equipment regulations
• Medical history and records, patient and professional communication
• Medical ethics, informed choice/consent/negligence and maxillofacial prosthetics practice

**Risk management and governance**
• Compliance with the requirements of the Medical Devices Directive (MDD)
• Clinical Governance framework
• Current standards and compliance in the healthcare environment, including Standards for Better Health, NHS Litigation Authority
• Management of innovation and prototype devices and treatment

**Management of patient**
• Patient evaluation and referrals
• Management of patient’s fears/anxiety and ability to empathise with patients in stressful situations, and the manifestations of anxiety/pain and the range of methods available in their management and control
• Personal and professional interaction with terminally ill patients, including counselling skills
• Theories and evidence base underpinning health-related behaviour
• The effects of drugs, allergies and lifestyle factors on patient health and rehabilitation
• Risks and benefits of care/management for the patient and their family/partners/carers
• Common psychosocial disorders (abnormal psychology, anxiety, depression, psychoses, eating disorders, alcoholism and drug addiction)
• Recognition and appropriate care of patients with tissue conditions (psoriasis, eczema, contact dermatitis, dry mouth, sore mouth/mouth burning syndromes)
- Dementia, Alzheimer’s, Parkinson’s disease
- Process of grief and loss
- Body image and effect of altered body image
- Patient-centred counselling skills, including the importance of appropriate location and the amount of time devoted to the task
- Role of support groups (physical and internet)
- Principles of patient education and supporting patients to be actively involved in their care
- Quality of life outcome measurement and analysis
- Care pathways and referral for social and psychological support
Appendix 1: Contributor List

Members of the STP MSc and Work Based Programme in Reconstructive Science

Development of the STP Programme (MSc Clinical Sciences and Work Based programme) for Reconstructive Sciences 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:

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National School of Healthcare Science Professional Lead
Dr Chris Gibson
Appendix 2: Programme Amendments

MSc Clinical Sciences (Reconstructive Science)
Amendments Following Publication
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 Probity

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

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

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

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

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

1.3 Working with colleagues

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

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

1.3.3 Consult and take advice from colleagues where appropriate

1.3.4 Be readily accessible when you are on duty

1.3.5 Respect the skills and contributions of your colleagues

1.3.6 Participate in regular reviews of team performance.

1.4 Training and developing others

1.4.1 Contribute to the education and training of colleagues

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

1.4.3 Ensure that junior colleagues and students are properly supervised

1.4.4 Support colleagues who have difficulties with performance, conduct or health

1.4.5 Share information with colleagues to protect patient safety

1.4.6 Provide work-based development for colleagues to enhance/improve skills and knowledge
Domain 2: Scientific Practice

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

2.1 Scientific Practice

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

2.2 Technical Practice

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

2.3 Quality

2.3.1 Set, maintain and apply quality standards, control and assurance techniques for interventions across all clinical, scientific and technological activities
2.3.2 Make judgements on the effectiveness of processes and procedures
2.3.3 Participate in quality assurance programmes
2.3.4 Maintain an effective audit trail and work towards continuous improvement
Domain 3: Clinical Practice

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

3.1 Clinical Practice

3.1.1 Ensure that you and the staff you supervise understand the need for and obtain relevant consent before undertaking any investigation, examination, provision of treatment, or involvement of patients and carers in teaching or research

3.1.2 Ensure that you and the staff you supervise maintain confidentiality of patient information and records in line with published guidance

3.1.3 Ensure that you and your staff understand the wider clinical consequences of decisions made on your actions or advice

3.1.4 Demonstrate expertise in the wider clinical situation that applies to patients who present in your discipline

3.1.5 Maintain up to date knowledge of the clinical evidence base that underpins the services that you provide and/or supervise and ensure that these services are in line with the best clinical evidence

3.1.6 Plan and determine the range of clinical/scientific investigations or products required to meet diagnostic, therapeutic, rehabilitative or treatment needs of patients, taking account of the complete clinical picture

3.1.7 Plan and agree investigative strategies and clinical protocols for the optimal diagnosis, monitoring and therapy of patients with a range of disorders

3.1.8 Ensure that detailed clinical assessments are undertaken and recorded using appropriate techniques and equipment and that the outcomes of these investigations are reviewed regularly with users of the service

3.1.9 Ensure the provision of expert interpretation of complex and or specialist data across your discipline in the context of clinical questions posed

3.1.10 Undertake and record a detailed clinical assessment using appropriate techniques and equipment

3.1.11 Provide specialised clinical investigation and/or analysis appropriate to your discipline

3.1.12 Provide interpretation of complex and/or specialist data in the context of the clinical question posed

3.1.13 Provide clinical advice based on results obtained, including a diagnostic or therapeutic opinion for further action to be taken by the individual directly responsible for the care of the patient

3.1.14 Provide expert clinical advice to stakeholders in order to optimise the efficiency and effectiveness of clinical investigation of individuals and groups of patients

3.1.15 Prioritise the delivery of investigations, services or treatment based on clinical need of patients

3.1.16 Represent your discipline in multidisciplinary clinical meetings to discuss patient outcomes and the appropriateness of services provided
3.1.17 Ensure that regular and systematic clinical audit is undertaken and be responsible for modifying services based on audit findings.

3.2 Investigation and reporting

3.2.1 Plan and conduct scientific, technical, diagnostic, monitoring, treatment and therapeutic procedures with professional skill and ensuring the safety of patients, the public and staff

3.2.2 Perform investigations and procedures/design products to assist with the management, diagnosis, treatment, rehabilitation or planning in relation to the range of patient conditions/equipment within a specialist scope of practice

3.2.3 Monitor and report on progress of patient conditions/use of technology and the need for further interventions.

3.2.4 Interpret and report on a range of investigations or procedures associated with the management of patient conditions/equipment

Domain 4: Research, Development and Innovation

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

4.1 Research, Development and Innovation

4.1.1 Search and critically appraise scientific literature and other sources of information

4.1.2 Engage in evidence-based practice, participate in audit procedures and critically search for, appraise and identify innovative approaches to practice and delivery of healthcare

4.1.3 Apply a range of research methodologies and initiate and participate in collaborative research

4.1.4 Manage research and development within a governance framework

4.1.5 Develop, evaluate, validate and verify new scientific, technical, diagnostic, monitoring, treatment and therapeutic procedures and, where indicated by the evidence, adapt and embed them in routine practice

4.1.6 Evaluate research and other available evidence to inform own practice in order to ensure that it remains at the leading edge of innovation.

4.1.7 Interpret data in the prevailing clinical context

4.1.8 Perform experimental work, produce and present results

4.1.9 Present data, research findings and innovative approaches to practice to peers in appropriate forms

4.1.10 Support the wider healthcare team in the spread and adoption of innovative technologies and practice

Domain 5: Clinical Leadership
All patients and service users have a right to expect that Healthcare Science services efficiently and effectively managed to meet service needs. As a leader in Healthcare Science, you will seek to effectively:

### 5.1 Leadership

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

*Good Scientific Practice AHCS V.2 Final  
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 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 to improve 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><strong>Learning framework</strong></td>
<td>The specification for work based learning contained within the Learning Guide.</td>
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<td>------------------------</td>
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</tr>
<tr>
<td><strong>Learning module</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Learning outcome</strong></td>
<td>A high-level, outcome-based statement that describes what a trainee will be able to do at the end of the module.</td>
</tr>
<tr>
<td><strong>Mentoring</strong></td>
<td>Mentoring is <em>a process in which a trainer (mentor) is responsible for overseeing the career and development of the trainee</em>. The emphasis is therefore on the relationship (rather than the activity).</td>
</tr>
<tr>
<td><strong>Module aim</strong></td>
<td>The overall objective of a work based learning module – defining the intended learning achievements of the trainee. The aim works together with the ‘Scope’ statement to define the overall objectives and scope of the module.</td>
</tr>
<tr>
<td><strong>Module scope</strong></td>
<td>A statement within work based learning modules that defines the range/limits of the learning undertaken by the trainee in a module – patients/investigations/equipment/modalities, etc.</td>
</tr>
<tr>
<td><strong>National Occupational Standards</strong></td>
<td>Nationally recognised standards of expected workplace performance and level of competence for a role. The standards are outcome based, defining what the role holder should to be able to do, as well as what they must know and understand to demonstrate competent work performance. National Occupational Standards are supported by nationally agreed frameworks of expected attitudes, behaviour and skills.</td>
</tr>
<tr>
<td><strong>Practical skill</strong></td>
<td>A cognitive, psychomotor, physical, or communicative ability that supports performance of required role.</td>
</tr>
<tr>
<td><strong>Programme</strong></td>
<td>The package of learning, teaching assessment and quality assurance leading to an award.</td>
</tr>
<tr>
<td><strong>Provider</strong></td>
<td>An organisation that delivers required training and learning activities to specified quality assurance requirements</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>A collection of functions undertaken in the workplace that represent the main broad areas of work for all similar workers at national level. A role differs from a job, the latter being defined specifically for a local context.</td>
</tr>
<tr>
<td><strong>Specialism</strong></td>
<td>A focused area of practice within a theme of healthcare science.</td>
</tr>
<tr>
<td><strong>Trainer</strong></td>
<td>A qualified individual who provides learning and development support for trainees.</td>
</tr>
<tr>
<td><strong>Theme</strong></td>
<td>A cluster of related specialisms within a division of healthcare science.</td>
</tr>
<tr>
<td><strong>Work-based learning</strong></td>
<td>Learning that takes place in a real work setting and involves the application of academic learning to real work activities.</td>
</tr>
<tr>
<td><strong>Work performance</strong></td>
<td>The requirements of satisfactory and consistent demonstration of competence in specified functions for a work role.</td>
</tr>
<tr>
<td><strong>Workplace</strong></td>
<td>A real work setting in which the trainee can apply learning.</td>
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</tbody>
</table>