Modernising Scientific Careers
Scientist Training Programme
MSc in Clinical Science

Blood Sciences 2017/18
Section 1: Introduction to Modernising Scientific Careers (MSC) and the Scientist Training Programme (STP) ................................................................. 6
  1.1 Introduction to Modernising Scientific Careers (MSC) .................. 6
  1.2 Introduction to the Scientist Training Programme (STP) .............. 6
  1.3 Scientist Training Programme Outcomes .................................. 7
  1.4 Overview of the MSc Clinical Science Programme ...................... 9

Section 2: Entry Routes, Award Title, Delivery, Accreditation of Prior Learning ....... 11
  2.1 Entry Routes ........................................................................... 11
  2.2 Progression ........................................................................... 11
  2.3 Award Titles ........................................................................... 11
  2.4 Mode of Delivery: Part-time ......................................................... 12
  2.5 Relevant Quality Assurance Agency (QAA) Code(s) of Practice .... 12
  2.6 Awarding Body ...................................................................... 12
  2.7 Accreditation of Prior Learning ............................................... 12
  2.8 Programme Delivery and Monitoring ...................................... 12

Section 3: The MSc Clinical Science Curriculum .................................. 13
  3.1 Purpose ................................................................................. 13
  3.2 Curriculum Development and Maintenance .............................. 13
  3.3 Tender Process and Monitoring .................................................. 14
  3.4 MSC Accreditation .................................................................. 14
  3.5 Programme Delivery ................................................................. 14
  3.6 Academic Induction .................................................................. 15
  3.7 Teaching and Learning ............................................................... 15
  3.8 Interprofessional Learning ......................................................... 17
  3.9 Patient and Public Involvement ................................................. 17

Section 4: Assessment ...................................................................... 18
  4.1 Purpose of Assessment ............................................................... 18
  4.2 Key areas that must be covered by the Assessment Strategy include: ... 19

Section 5: Trainee Supervision, Support and Mentoring ........................ 20
  5.1 Fitness to Practise ..................................................................... 20

Section 6: Progression, Annual Monitoring of Progress, Equality and Diversity, Curriculum Review and Updating .................................................. 21
  6.1 Progression ............................................................................ 21
  6.2 Annual Monitoring of Progress .................................................. 21
  6.3 Equality and Diversity ............................................................... 21
  6.4 Curriculum Review .................................................................. 21

Section 7: Relationships and Partnerships ......................................... 22
  7.1 National School of Healthcare Science ..................................... 22
  7.2 The Academy for Healthcare Science ....................................... 22

Section 8: Professional Practice ......................................................... 24
Section 9: MSc Clinical Science (Blood Sciences) .................................................. 26
  9.1 Overview of STP in Blood Sciences .......................................................... 26
  9.2 Blood Sciences Route Map ........................................................................ 26
Section 10: Generic Modules ........................................................................... 28
Generic Curriculum .......................................................................................... 28
  Introduction to Healthcare Science, Professional Practice and Clinical Leadership ................................................................. 28
  Research Methods .......................................................................................... 34
Section 11: Division/Theme-Specific Modules ............................................... 37
  Introduction to Blood Science ..................................................................... 37
  CB-1: Investigation of Major Organ Function ............................................ 37
  HT-1: Introduction to Haematology and Transfusion Science ..................... 39
  CI-1: Immunity and the Principles and Practice of Clinical Immunology ...... 41
  Genetics, Genomics and Molecular Science ............................................. 43
Section 12: MSc Clinical Science Specialist Modules for Clinical Biochemistry ...... 46
  Clinical Disorders of the Major Organs and Cancer .................................. 47
  Endocrinology and Diabetes ...................................................................... 49
  Research Project in Clinical Biochemistry ............................................... 51
  Nutrition ....................................................................................................... 52
  Drug Investigation ....................................................................................... 54
  Pregnancy, Neonatal and Paediatric Clinical Biochemistry ......................... 56
Section 13: MSc Clinical Science Specialist Modules for Clinical Immunology ...... 58
  Immunology and Infection ......................................................................... 59
  Immunodeficiency and Immunotherapy ..................................................... 60
  Research Project in Clinical Immunology ................................................... 62
  Hypersensitivity and Allergy ...................................................................... 64
  Haematological Malignancies and Transplantation .................................... 66
  Autoimmunity .............................................................................................. 67
Section 14: MSc Clinical Science Specialist Modules for Haematology and
  Transfusion Science ..................................................................................... 69
  Disorders of Red and White Blood Cells .................................................... 70
  Core Transfusion ......................................................................................... 72
  Research Project in Haematology and Transfusion Science ......................... 74
  Haemostasis ................................................................................................ 75
  Haematological Malignancy ....................................................................... 77
  Transfusion .................................................................................................. 78
Section 15: MSc Clinical Science Specialist Modules for Histocompatibility and
  Immunogenetics ......................................................................................... 81
  Histocompatibility ...................................................................................... 82
  Immunodeficiency and Immunotherapy ...................................................... 83
  Hypersensitivity and Allergy ...................................................................... 85
  Haematological Malignancies and Transplantation ..................................... 86
  Haemopoietic Stem Cell Transplantation .................................................... 88
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 the 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) sets out the principles and values on which good practice within healthcare science are founded.1 It makes explicit the professional standards of behaviour and practice that must be achieved and maintained by all those who work in healthcare science. GSP and the Education and Training Standards of the Health and Care Professions Council (HCPC) together form the basis for all MSC training curricula which contextualise the Standards of Proficiency set down by the HCPC in a way that is accessible to the profession and the public.

3. The HCS 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 and a fourth Division – Clinical Bioinformatics has been identified. MSC recognises this important change and to date has identified thirteen STP themes within healthcare science, which enables training currently cross a total of 32 HCS specialisms, with curricula for additional specialisms still under development.

1.2 Introduction to the Scientist Training Programme (STP)

4. The STP is a three-year combined pre-registration work-based and postgraduate academic programme (MSc in Clinical Science). It is designed to provide clinical scientist trainees with a 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 up to four related healthcare science specialisms, reflective of the evolving clinical and scientific advances and requirements followed by specialisation in a single HCS specialism.

5. The STP integrates and combines academic study leading to the award of a specifically commissioned MSc in Clinical Science and a work-based training

---

1 https://www.google.co.uk/?gws_rd=ssl&q=academy+for+healthcare+science+good+scientific+practice
programme. Completion of both will lead to the award of a Certificate of Completion of the Scientist Training Programme (CCSTP) by the National School of HCS (NSHCS). Graduates are eligible to apply to the Academy for Healthcare Science (AHCS) for a Certificate of Attainment and will then be eligible to apply to HCPC for registration as a Clinical Scientist. Recruitment to the programme is competitive and in England, the NSHCS leads the national recruitment process.

1.3 Scientist Training Programme Outcomes

6. Graduates of the STP will possess the essential knowledge, skills, experience and attributes required of a newly qualified Clinical Scientist. They will have clinical and specialist expertise in a specific HCS specialism, underpinned by broader knowledge and experience within a HCS 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.

7. On completion of the STP all graduates should be able to demonstrate the following outcomes of the programme:

Professional Practice

- 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.
- 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.
- 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; providing mentoring, supervision and support as appropriate and understanding the importance of participation in training, supervision and mentoring.
- 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.
- The ability to work with public, service users, patients and their carers as partners in their care, embracing and valuing diversity being aware of the impact of culture, equality and diversity on practice.
- The ability to treat patients and their carers with respect, dignity and compassion in line with the NHS constitution.
- An understanding of the limits of the concept of confidentiality; the principles of information governance and safe and effective use of health and social care information and the ability to recognise and respond appropriately to situations where it is necessary to share information to safeguard service users or the wider public.

Scientific and Clinical Practice

- 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.
- 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.
- The ability to perform quality assured appropriate diagnostic or monitoring procedures, treatment, therapy or other actions safely and skillfully, adhering to applicable legislation and in compliance with local, national and international guidelines.
- The ability to maintain records appropriately recognising the need to manage records and all other information in accordance with applicable legislation, protocols and guidelines.
- The ability to deal with complex scientific and clinical issues both systematically and creatively, make sound judgments in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences, including patients and the public.
- The ability to define and choose investigative and scientific and/or clinical options, and make key judgments about complex facts in a range of situations.
- 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

- A comprehensive understanding of the strengths, weaknesses and opportunities for further development of healthcare and HCS as applicable to their own clinical practice, research, audit, innovation and service development, which either directly or indirectly leads to improvements in patient care, the patient experience, clinical outcomes and scientific practice.
- 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
- Scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.
- 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.
- An understanding of the structure and function of health and social care services in the UK and the concept of leadership and its application to practice.

1.4 Overview of the MSc Clinical Science Programme

8. This document sets out the proposed structure, high-level learning outcomes and indicative content for the three-year, part-time MSc in Clinical Science that forms part of the STP. The programme combines and integrates the generic professional practice learning, themed learning in a group of specialisms and individual programmes for each specialism.

9. Figure 1 depicts the overall structure and timing of each STP while Figure 2 depicts the broad framework around which all MSc Clinical Science programmes must be structured. Each division within the MSC has interpreted and adapted this framework in a way that is appropriate for the HCS theme.

Figure 1: Modernising Scientific Careers: 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

| Year 3 | Healthcare Science  
Specialist Learning with  
integrated Professional Practice | Research Project  
Students would usually begin a work-based research project in Year 2 and complete the project in Year 3 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specialist</td>
</tr>
</tbody>
</table>
| Year 2 | Research Methods  
[10] | Healthcare Science  
Specialist Learning with integrated Professional Practice | Research Project  
Students would usually begin a work-based research project in Year 2 and complete the project in Year 3 |
|       | Specialist                                      |
| Year 1 | Generic  
Healthcare Science  
Integrating science and  
Professional Practice  
[20] | Healthcare Science  
Integrating underpinning knowledge required for each rotational module with Professional Practice  
[40] | Division-theme |
|       | Generic  
Division-theme |

[XX] = number of credits

- **Generic modules:** Shared by all four divisions of Healthcare Science
- **Division-theme modules:** Shared by a Division or Theme of Healthcare Science
- **Specialist modules:** Specific to a Specialism of Healthcare Science
Section 2: Entry Routes, Award Title, Delivery, Accreditation of Prior Learning

2.1 Entry Routes

10. 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

11. 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

12. 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 (Genomics Sciences) – from 2017
  - 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)

- **Clinical Bioinformatics**
  - MSc Clinical Science (Clinical Bioinformatics)
  - MSc Applied Epidemiology
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**

13. HEIs should adhere to the current QAA Code of Practice for the Assurance of Academic Quality and Standards in Higher Education. Further details can be found on the QAA website: http://www.qaa.ac.uk/Assuring-standards-and-quality/the-quality-code

2.6 **Awarding Body**

14. 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**

15. 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. http://www.qaa.ac.uk/assuring-standards-and-quality/the-quality-code

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

2.8 **Programme Delivery and Monitoring**

16. 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

17. 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

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

All MSC curricula are subject to regular review, with all stakeholders given the opportunity to contribute to each review.

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

- Strategy for UK Life Sciences (December 2011)
- Strategy for UK Life Sciences One Year On (2012)
- Innovation Health and Wealth, Accelerating Adoption and Diffusion in the NHS (December 2011)

2 From 2016 all new curricula or updated versions are available on the NSHCS website http://www.nshcs.hee.nhs.uk/.
3.3 Tender Process and Monitoring

20. 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

21. 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

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

23. 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.

24. 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

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

3.7 Teaching and Learning

26. 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’\(^3\) 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

\(^{27}\) It is also expected that e-learning and m-learning\(^4\) 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.

---

\(^4\) *JISC TechDis*: see [http://www.jisctechdis.ac.uk/technologymatters/mobilelearning](http://www.jisctechdis.ac.uk/technologymatters/mobilelearning) for further information with respect to mobile (m) learning.
3.8 Interprofessional Learning

28. 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

29. 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

30. 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.

31. The MSc Clinical Science assessment programme should support assessment for learning, and in particular:\(^6\)

- 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.

32. 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.

33. 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.

34. The approach to assessment should include and be overseen by a central coordinating leadership group or assessment-focused group who oversee, advise and scrutinise assessment across modules and years in order to build a consistent approach to assessment across the whole programme, involving

\(^5\) Quality Assurance Agency UK Quality Code for Higher Education.

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 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

35. 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

36. 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

37. 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

38. 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

39. All programmes should reference and be able to demonstrate evidence of adherence to the Equality Act 2010 and the QAA Single Equality Scheme (SES).

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:

- Equal Pay Act 2012
- Human Rights Act 1998

6.4 Curriculum Review

40. The review and updating of this STP 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: nshcs@wm.hee.nhs.uk
Section 7: Relationships and Partnerships

7.1 National School of Healthcare Science

41. 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.

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

The School can be contacted on the following email: nshcs@wm.hee.nhs.uk

7.2 The Academy for Healthcare Science

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

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

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

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

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

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

Good Scientific Practice uses as a benchmark the Health and Care Professions Council (HCPC) 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 and innovation
5. Clinical Leadership

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

<table>
<thead>
<tr>
<th>Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On successful completion of this module the trainee will be able to, in the context of Blood Sciences:</td>
</tr>
<tr>
<td>1. Present complex ideas in simple terms in both oral and written formats;</td>
</tr>
<tr>
<td>2. Consistently operate within sphere of personal competence and level of authority;</td>
</tr>
<tr>
<td>3. Recognise the need to manage their own workload and resources effectively and be able to practise accordingly;</td>
</tr>
<tr>
<td>4. Manage personal workload and objectives to achieve quality of care;</td>
</tr>
<tr>
<td>5. Actively seek accurate and validated information from all available sources;</td>
</tr>
<tr>
<td>6. Select and apply appropriate analysis or assessment techniques and tools;</td>
</tr>
<tr>
<td>7. Evaluate a wide range of data to assist with judgements and decision making;</td>
</tr>
<tr>
<td>8. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others;</td>
</tr>
<tr>
<td>9. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration;</td>
</tr>
<tr>
<td>10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.</td>
</tr>
</tbody>
</table>

The following sections of this MSc Curriculum provide an overview of the STP for the specialism(s) within this theme. The Generic, Division and Themed Learning Outcomes and Indicative Content of the curriculum, together with the high-level work-based learning outcomes, follow this.
Section 9: MSc Clinical Science (Blood Sciences)

9.1 Overview of STP in Blood Sciences

The diagram below provides an overview of the STP each trainee in Blood Sciences 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 Blood Sciences Route Map

The route map overleaf shows how the high-level framework has been interpreted for the MSc in Clinical Science (Blood Sciences) for four specialisms, namely:

ii. Clinical Biochemistry
iii. Haematology and Transfusion Science
iii. Clinical Immunology
iv. Histocompatibility and Immunogenetics
MSc Clinical Sciences: Blood Science Route Map

Year 1
- Introduction to Healthcare Science, Professional Practice and Clinical Leadership [20]
- Introduction to Blood Sciences – underpinning knowledge for rotational work-based training [40]

Year 2
- Research Methods [10]

Year 3
- Research Project [30]

Clinical Biochemistry
- Clinical Disorders of the Major Organs and Cancer [10]
- Endocrinology and Diabetes [10]
- Research Project [30]
- OR
- Drug Investigation [10]
- Pregnancy, Neonatal and Paediatric Clinical Biochemistry [10]

Haematology and Transfusion
- Disorders of Red and White Blood Cells [10]
- Core Transfusion [10]
- Research Project [30]
- OR
- Haemostasis [10]
- Transfusion [10]

Clinical Immunology
- Immunology and Infection [10]
- Immunodeficiency and Immunotherapy [10]
- Research Project [30]
- OR
- Hypersensitivity and Allergy [10]
- Haematological Malignancies and Transplantation [10]

Histocompatibility & Immunogenetics
- Clinical Immunology in Histocompatibility and Immunogenetics [10]
- Histocompatibility [10]
- Research Project [30]
- OR
- Solid organ transplantation [10]
- Haematopoietic Stem Cell Transplantation [10]

Credits

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

Route map of MSc Clinical Science (Blood Sciences) with specialism in Clinical Biochemistry, Haematology and Transfusion Sciences, Clinical Immunology and, Histocompatibility and Immunogenetics. In Year 1, trainees begin by following the generic curriculum, which spans all divisions (blue) together with division/theme-specific modules to support the rotational work-based programme (yellow). In Year 2 of the MSc, trainees begin to study in their specialist area (orange) and by Year 3 the entire curriculum is focused on the specialism.
Section 10: Generic Modules

Generic Curriculum

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

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

The generic STP work-based programme generic curriculum modules are:

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

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

### Year 1: Generic Module

Introduction to Healthcare Science, Professional Practice and Clinical Leadership  
[20 credits]

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

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

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

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

**Scientific Basis of Healthcare Science**

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

**Professional Practice**

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

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

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

Indicative Content

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

Review of pathophysiology: cellular, tissue and systems responses to disease
- Review of the pathological processes underpinning common diseases:
  - cell death
  - inflammation
  - neoplasia
  - hypertrophy
hyperplasia
- 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
- Gathering information
- Building the relationship
- Explaining and planning
- Closing the session

- Link between the patient history and examination and development of clinical investigation and management plans
- Shared clinical decision making
- How information from a history and examination is used to develop clinical management plans

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

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

**Introduction to the structure of the NHS**
- Structure of the NHS across the four UK countries
  - Structure
  - Accountabilities
  - Funding arrangements
Working relationships
- NHS Constitution
  - 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
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 Blood Science

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

Division: Life Sciences
Theme: Blood Sciences
Year 1: Introduction to Blood Sciences [40 credits]

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

For ease of understanding the module has been broken down into four modules each of 10 credits (three from Blood Sciences and Genetics and Molecular Science from the STP Genetics programme). It is recognised that these four modules need not be delivered as separate entities.

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 integrate. The full work-based Learning Guide can be found at: http://www.networks.nhs.uk/nhs-framework-curricula/stp

All trainees will undertake the MSc modules listed below.

Division: Life Sciences
Theme: Blood Sciences
Year 1: Introduction to Blood Sciences [40 credits in total]
- Clinical Biochemistry Rotation: CB-1: Investigation of Major Organ Function [10 credits]
- Haematology and Transfusion Science Rotation: HT-1: Introduction to Haematology and Transfusion Science [10 credits]
- Clinical Immunology Rotation: CI-1: Immunity and the Principles and Practice of Clinical Immunology [10 credits]
- Genomic Sciences: CG-1: Genetics, Genomics and Molecular Science [10 credits]

Clinical Biochemistry Rotation [10 credits]
CB-1: Investigation of Major Organ Function

This module will provide the trainee with the knowledge and understanding of the normal physiology of the major organs and the biochemical parameters in common use for the investigation and management of major organ dysfunction. In the work-based module they will be expected to apply this

---

From 2016 all new curricula or updated versions are available on the NSHCS website http://www.nshcs.hee.nhs.uk/
knowledge as they learn to perform common methods used in the investigation of major organ function and gain experience of the interpretation of patient results in a variety of clinical settings.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain normal physiological homeostasis of the major organs.
2. Describe and explain the pathophysiology and cause of common disorders of the major organs.
3. Explain the presentation, diagnosis and management of common biochemical disorders of major organ function.
4. Describe and evaluate the principles of common biochemical measurement techniques used to investigate major organ function.
5. Describe the design, operation and performance of automated analytical platforms used to investigate major organ function.
6. Describe the design, operation and performance of point-of-care testing devices supported by the clinical biochemistry laboratory.
7. Discuss and justify the biochemical investigation of major organ disease in the patient pathway, the correct sampling technique and the use and validity of reference ranges.
8. Explain and justify the principles of internal quality control (IQC) and external quality assessment (EQA).
9. Explain the use of laboratory information technology (IT) systems for handling, processing and storage of patient data.
10. Discuss the partnership of clinical biochemistry to other clinical specialisms in the investigation of disorders of major organs and patient care.

**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. Interpret routine requests for clinical biochemistry investigations of major organ function in the correct clinical context and process the specimens that accompany those requests.
2. Perform a range of laboratory and point-of-care techniques (POCTs) used in the workplace to investigate major organ function.
3. Apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
4. Report the results of commonly performed clinical biochemistry investigations of major organ function.
5. Use laboratory IT systems for handling, processing and storage of patient data.
Indicative Content

- The normal physiology and function of the following major organs: kidney, liver, heart, lungs, bone and pancreas. To include water homeostasis and acid–base balance
- The clinical and scientific basis of common biochemical markers of function of the kidney, liver, heart, lungs, bone and pancreas
- The application of common biochemical markers of major organ function to a range of frequently encountered clinical disorders
- Presentation, diagnosis and management of common clinical biochemical disorders of major organ function
- The biological and statistical basis of biological variation, reference values and action limits
- Principles and practice of IQC and EQA
- Scientific basis of the following techniques: spectrophotometry, osmometry, ion selective electrodes, enzymology, immunochemical techniques, electrophoresis, chromatography and solid phase chemistry
- Design, operation and performance of automated analytical platforms, including random access, modular, robotics, etc.
- Design, operation and performance of point-of-care testing devices supported by the clinical biochemistry laboratory

Haematology and Transfusion Science Rotation

HT-1: Introduction to Haematology and Transfusion Science
[10 credits]

This module will provide the trainee with the knowledge and understanding of the formation of blood cells, the mechanism of haemostasis and the relevance of blood group antigens and antibodies. They will understand the principles and practice of common methods used in haematology, haemostasis and blood transfusion and perform some of them in the laboratory. They will understand common clinical disorders associated with abnormal haematology and haemostasis and gain experience of the interpretation of patient results in a variety of clinical settings. They will gain knowledge of blood transfusion in a variety of settings, and understand how to provide patients with safe and effective transfusion support.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the haemopoietic pathways and normal haemostatic mechanisms, and discuss disorders causing bleeding or thrombosis.
2. Describe the design, operation and performance of the routine tests used in screening and investigating haematological disorders and their normal limits.
3. Describe the design, operation and performance of the tests used to investigate disorders of haemostasis.
4. Discuss the concept of blood groups and the application of blood group serology in establishing compatibility between patient and donor.
5. Describe the design, operation and performance of the tests and
procedures required to enable selection of safe and appropriate blood and blood components for patients with a range of clinical conditions.

6. Know the range of blood components and products in common use and the importance of correct storage.

7. Explain and justify legislation and guidance relevant to blood transfusion practice.

8. Discuss the partnership of haematology and transfusion science to other clinical specialisms in the investigation and management of common disorders and patient care.

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. Perform a range of laboratory techniques used in screening and investigating haematological disorders.
2. Perform the range of laboratory and point-of-care techniques (POCTs) used in the investigation of disorders of haemostasis.
3. Perform blood group serology in the context of pre-transfusion testing.
4. Select safe and appropriate blood and blood components for patients with a range of clinical conditions.
5. Apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
6. Use laboratory IT systems for handling, processing and storage of patient data.

Indicative Content

- Normal haemopoiesis and bone marrow function in the development and differentiation of blood cells
- Normal haemostasis and its components
- Role of the liver in the production of coagulation factors
- Principles, scientific basis and clinical application of commonly performed analytical procedures in haematology
- Principles and scientific basis of automated coagulation analysers and point-of-care instruments in the assessment of coagulation function
- Principles and scientific basis of automated cell counters and point-of-care instruments for numeration and identification of cellular blood components
- Point of care testing in haematology
- Presentation, diagnosis and management of common haematological disorders
- The establishment, application and limitations of biological normal reference ranges, including age, ethnic and sex related reference ranges
Bone marrow aspiration, trephine biopsy, preparation and staining techniques for the morphological identification of cells in bone marrow in normal and pathological conditions
- Blood film preparation, staining and interpretation in normal and pathological conditions, including parasites
- Principles and application of internal quality control and external quality assurance programmes
- Basic blood group systems – genes, antigens and antibodies
- Manual and automated techniques for ABO/D typing, serological crossmatching, red cell phenotyping, antibody screening and identification
- Overview of blood transfusion services and range of blood components/products manufactured and their applications
- Principles of pre-transfusion testing
- Normal ranges and predictive values for pathology tests used to inform transfusion support
- Aetiology and clinical features of conditions requiring transfusion support
- Overview of legislation / guidelines relevant to blood transfusion practice

**Clinical Immunology Rotation**

CI-1: Immunity and the Principles and Practice of Clinical Immunology

[10 credits]

This module will provide the trainee with an introduction to the immune system and immune responses. They will understand the organisation and delivery of a clinical immunology laboratory service. In the work-based module they will be expected to apply this knowledge as they learn to perform some common methods used in clinical immunology and gain an understanding of the interpretation of patient results in a variety of clinical settings.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain the function of the immune system in health and the function of the major cells of the immune system.
2. Explain the function of the major humoral components of the immune response.
3. Explain the innate immune system and the adaptive immune response.
4. Discuss the co-dependence of the innate and adaptive immune systems.
5. Describe and evaluate the design, operation and performance of the tests and assays used within clinical immunology.
6. Describe the partnership of clinical immunology to other clinical specialisms in the investigation and management of disorders of the immune system and patient care.

**CLINICAL IMMUNOLOGY**

**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. Interpret routine requests for common clinical immunology investigations in the correct clinical context and process the specimens that accompany those requests.
2. Use laboratory IT systems for handling, processing and storage of patient data.
3. Perform a range of laboratory techniques used in the workplace in clinical immunology.
4. Report the results of commonly performed clinical immunology investigations of major organ function.
5. Apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.

HISTOCOMPATIBILITY AND IMMUNOGENETICS ONLY

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. Interpret routine requests for common H&I investigations in the correct clinical context and process the specimens that accompany those requests.
2. Use laboratory IT systems for handling, processing, storing and retrieving patient data.
3. Perform a range of laboratory techniques used in the workplace in H&I.
4. Report the results of commonly performed H&I investigations.
5. Apply the principles of internal quality control and external quality assessment and draw appropriate conclusions about assay performance.

Indicative Content

- Organisation and components of the immune system
  - Cellular components (lymphocytes, granulocytes, monocytes/macrophages)
  - Humoral components (antibodies/immunoglobulins, complement, cytokines)
  - Molecules of the immune system (major histocompatibility molecules class I and II, cluster of differentiation (CD) molecules/cell surface)
markers, receptor molecules, recognition molecules, adhesion molecules, effector molecules)
  o Antigen presentation

- Innate immune response (endothelial cells, neutrophils, macrophages, natural killer cells, complement)
- Adaptive immune response (antigen processing, dendritic cells, T cell responses, B cell responses, primary and secondary responses, vaccination/immunisation)
- Outcome of immune responses (immunity/immunological memory, inflammation, direct and indirect functions of antibodies, incidental tissue damage, hypersensitivity and allergy)

**Division: Life Sciences**  
**Theme: Blood Sciences (Shared with Cellular Sciences and Genomic Sciences)**  
**Genetics, Genomics and Molecular Science**  
**CG-1 [10 credits]**

This module will provide the trainee with an introduction to human genetics, genomics and molecular science. They will understand the organisation and delivery of a genetics and genomics laboratory service. In the work-based module, they will be expected to apply this knowledge as they learn to perform some common scientific technical methodologies used in genomics, gain an understanding of the interpretation of patient results in a variety of clinical settings and understand the impact of genomics on patients and their families.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will be able to:

1. Explain nucleic acid and chromosome structure and function.
2. Explain and apply the nomenclature used to describe the human genome.
3. Discuss patterns of inheritance.
4. Describe and evaluate the design, operation and performance of methods used to investigate genetic and genomic alterations associated with disease.
5. Describe the partnership of genetics and genomics with other clinical specialisms in the investigation and management of genetic and genomic disorders and the contribution to patient care.

**Learning Outcomes: Associated Work-Based Learning**

This is a 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 be able to:

1. Observe and reflect on the patient pathway from sample receipt to
issuing of the clinical reports for a range of genetic referrals.
2. Observe and reflect on preparation of samples for genetic analysis in current use.
3. Apply the correct genetic nomenclature to genetic alterations, including International System for Chromosome Nomenclature (ISCN) and Human Genome Variation Society (HGVS) nomenclature.
4. Identify the appropriate testing strategy for a range of referral reasons.
5. Apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
6. Assist with the interpretation and reporting of laboratory results in the context of named genetic disorders.
7. Participate in activities that involve working in partnership with other clinical specialisms in the investigation of patients referred for genetic disorders.

Indicative Content

**Nucleic acid and chromosome structure and function**
- Introduction to the human genome
- Cell biology, meiosis and mitosis
- Chromosome structure and function
- Mechanisms of origin of numerical and structural abnormalities, and behaviour of structural chromosome anomalies at meiosis
- Nucleic acid structure and function, chemical structure of DNA and replication, transcription and translation

**Nomenclature used to describe the human genome**
- Current Human Genome Variation Society (HGVS) and International System for Chromosome Nomenclature (ISCN)

**Patterns of Inheritance**
- Autosomal dominant and recessive
- X-linked
- Non-Mendelian disorders

**Design, operation and performance of methods used to investigate genetic and genomic diseases**
- Introduction to the molecular basis of disease
- Current laboratory techniques, specifically: PCR, DNA sequencing, chromosomal microarrays, FISH, fragment analysis, cell culture, DNA extraction from lymphocytes and chromosome analysis
- Analytical and clinical sensitivity and specificity of these tests
- Analysis and interpretation of genetic variation in a clinical context
- Accurate clinical report writing
- The use of bioinformatic tools
- Potential application of relevant emerging technologies

**Partnership of genetics with other clinical specialisms**
- Multi-disciplinary team working
• The impact of genomics on patients and their families
## Section 12: MSc Clinical Science Specialist Modules for Clinical Biochemistry

<table>
<thead>
<tr>
<th>Year 1 Core Modules</th>
<th>Introduction to Healthcare Science, Professional Practice and Clinical Leadership</th>
<th>[20]</th>
<th>Introduction to Blood Sciences Underpinning knowledge for rotational elements and integrated professional practice</th>
<th>[40]</th>
</tr>
</thead>
</table>

- **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
These modules provide the trainee with the knowledge that underpins the specialist module in Clinical Biochemistry and provides trainees with the knowledge and understanding that underpins and is applied to work-based learning.

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Biochemistry  
**Year 2:** CB-2  
**Clinical Disorders of the Major Organs and Cancer**  
[10 credits]

This module will provide the trainee with detailed knowledge and understanding of the clinical disorders of major organ function, and the clinical and laboratory methods used in diagnosis and management. They will understand the aetiology and biochemical investigation of a range of malignancies. In the work-based module they will be expected to apply this knowledge as they learn to perform and assure a range of manual, semi-automated and automated methods used in the investigation of major organ function and cancer. They will gain extensive experience of the interpretation of patient results in a variety of clinical settings.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the clinical investigation of hydrogen, water and electrolyte homeostasis, and blood gases, and discuss the causes and consequences of abnormal results.
2. Describe and evaluate the function of the kidney in a range of pathological conditions and the monitoring of biochemical parameters controlled by renal replacement therapy.
3. Explain the use of liver function tests to differentiate the cause of liver disease, assess the degree of liver damage and/or remaining function in a range of pathological conditions.
4. Describe and differentiate the causes of abnormal cardiac function, assess the degree of damage to cardiac tissue and monitor treatment.
5. Explain the process of normal bone modelling/remodelling in health and disease and the investigation of normal and abnormal bone metabolism and calcium homeostasis.
6. Discuss the role clinical biochemistry plays in the screening, diagnosis and treatment of common cancers and the contribution to patient care.
7. Explain the properties and functions of a range of specific proteins in health and disease.
8. Discuss the partnership of clinical biochemistry with other clinical specialisms in the investigation of major organ function and cancer and patient care.

### 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.

1. Perform the range of laboratory and point-of-care testing techniques used in the workplace to investigate major organ function.
2. Perform clinical and laboratory investigation of homeostatic mechanisms.
3. Perform clinical and laboratory investigation of kidney function and renal replacement therapy.
4. Perform clinical and laboratory investigation of liver function.
5. Perform clinical and laboratory investigation of cardiac function in acute and chronic conditions.
7. Apply Clinical Biochemistry to the screening, diagnosis and treatment of common cancers.
8. Perform clinical and laboratory investigation of disorders associated with specific protein abnormalities.
9. Interpret and report clinical and laboratory investigation and analysis in the correct clinical context.

Indicative Content

- Water and electrolytes: distribution of fluid and electrolytes; renin angiotensin aldosterone system, antidiuretic hormone, natriuretic peptides, hyper- and hypovolaemia; hyper- and hyponatraemia; hyper- and hypokalaemia; metabolic effects of trauma/stress/surgery; principles of IV fluid replacement therapy
- Renal function: assessment of glomerular function; salt and water homeostasis; hydrogen ion homeostasis; uraemia; definition and assessment of acute kidney injury; definition and assessment of chronic renal failure; renal replacement therapy; renal transplantation; renal tubular acidosis; renal stones
- Liver function: formation of bilirubin; enterohepatic circulation and bile salts; jaundice; hepatitis; cirrhosis; haemochromatosis; alcohol/drug hepatotoxicity; fatty liver disease; Wilson’s disease; cholestasis; biliary obstruction; gallstones; hepatoma; liver transplantation
- Cardiac function: apolipoproteins and cholesterol metabolism; hyperlipidaemia; atheroma; acute coronary syndromes; chronic heart failure; hypertension; cardiovascular risk stratification; primary and secondary cardiovascular disease prevention
- Lung function: respiratory and renal mechanisms in acid–base balance; acidosis; alkalosis; tissue oxygenation; acute and chronic respiratory disease
- Bone function: structure and function of bone; calcium and magnesium homeostasis; vitamin D; hyper- and hypocalcaemia; disorders of phosphate; disorders of magnesium; rickets and osteomalacia; osteoporosis; Paget’s disease; renal osteodystrophy
- Cancer: causes of malignancy; tumour growth and metastasis; molecular basis of malignancy; blood and urinary tumour markers of breast, lung, prostate, ovarian, testicular, pancreatic, GI tract, bladder and thyroid
cancer; tissue-based tumour markers; tumour-related effects of malignancy; NHS bowel cancer screening programme

- Proteins: properties and functions of albumin, transport proteins, protease inhibitors; ceruloplasmin, immunoglobulins, CRP, cytokines; hyper- and hypoalbuminaemia; paraproteinaemia; cryoglobulinaemia; alpha-1 antitrypsin deficiency; plasmapheresis

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Biochemistry  
**Year 2:** CB-3  
**Endocrinology and Diabetes**  
[10 credits]

This module will provide the trainee with the knowledge and understanding of the normal physiology and pathophysiology of the major endocrine organs in the body. They will appreciate the importance of clinical and biochemical parameters in diagnosing, assessing the response to treatment and monitoring patients with common endocrine disorders. In the work-based module they will be expected to apply this knowledge as they learn to perform endocrine assays using a range of methods and gain experience of the interpretation of hormone results in common endocrine conditions.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain, compare and contrast the synthesis, secretion, metabolism and modes of action of hormones.
2. Describe the use of negative feedback systems and dynamic function tests to differentiate primary and secondary endocrine disorders.
3. Describe how to derive appropriate reference ranges and the importance of biological variation when interpreting hormone results.
4. Discuss and evaluate the clinical and laboratory investigation of a wide range of endocrine disorders.
5. Describe the design, operation and performance of the range of methods used in the measurement of hormones.
6. Explain and identify when interference can invalidate the validity of the result.
7. Explain the causes, classification and investigation of diabetes mellitus using the underpinning evidence base.
8. Describe the design, operation and performance of the range of laboratory and point-of-care methods used in the screening, diagnosis and monitoring of diabetes mellitus.
9. Describe the partnership of biochemical endocrinology to other clinical specialisms in the investigation of endocrine disorders and diabetes and patient care.

**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. Perform the range of laboratory techniques used in the workplace to investigate endocrine disorders and diabetes.
2. Undertake clinical and laboratory investigation and management of the following endocrine pathologies: pituitary, thyroid, gonadal and adrenal disorders; endocrine disorders of calcium metabolism and the gastrointestinal tract; and endocrine causes of obesity.
3. Perform clinical and laboratory investigation and analysis and management of diabetes mellitus.
4. Work in partnership with other clinical specialisms in the investigation of endocrine disorders and diabetes.
5. Interpret and report on clinical and laboratory investigations for endocrinology and diabetes in the correct clinical context.

**Indicative Content**

- Basic endocrinology, hormones and hormone action
- Methods used for measuring hormones in biological samples
- Biological variability and its impact on reference values in endocrinology
- Normal physiology and pathophysiology of:
  - pituitary gland (anterior and posterior)
  - thyroid gland
  - gonads (ovaries and testes)
  - adrenal glands
  - parathyroid glands
  - pancreas
  - adipose tissue
- Clinical and biochemical parameters for the diagnosis, treatment and monitoring of:
  - pituitary disorders
  - thyroid disorders
  - ovarian and testicular disorders
  - adrenal disorders
  - endocrine disorders of calcium metabolism
  - endocrine disorders of gastrointestinal function
  - endocrine causes of obesity
- Causes and classification of diabetes mellitus
- Clinical and biochemical parameters for the screening, diagnosis, treatment and monitoring of diabetes mellitus
- New developments in endocrinology

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Biochemistry
The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in a specialism of healthcare science. The research project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be designed to take into account the research training required by individual trainees and the needs of the department in which the research is to be conducted.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

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

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

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

5. Prepare a summary of the research project suitable for non-specialist and lay audiences.

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

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Biochemistry  
**Year 3:** CB-4  
**Nutrition**  
[10 credits]

This module will provide the trainee with the knowledge and understanding of normal nutrition and clinical disorders associated with malnutrition, malabsorption and obesity. Trainees will understand the normal biochemistry of haem synthesis, haematinics and contribute to the investigation of anaemia. They will be able to describe the role of trace elements and vitamins and clinical conditions associated with deficiency or excess. They will be able to assess energy balance and understand enteral and parenteral nutrition. They will appreciate the importance of clinical and biochemical parameters in diagnosing and managing nutritional disorders. In the work-based module they will be expected to apply this knowledge as they learn to perform assays to assess nutritional status using a range of methods and gain experience of the interpretation of results in a range of clinical conditions.
Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the need for macro- and micronutrients for normal health, growth, repair and reproduction.
2. Discuss the role of clinical biochemistry in the assessment of nutritional status (including that of patients requiring enteral and parenteral feeding).
3. Describe the design, operation and performance of biochemical techniques used to assess digestion and absorption.
4. Describe the design, operation and performance of biochemical techniques used in the assessment of pancreatic function and the detection of pancreatic disease.
5. Discuss the need to select appropriate sample and method for the estimation of trace elements and vitamins (including direct and indirect methods).
6. Discuss the role of clinical biochemistry in the assessment of trace element and vitamin status in health and disease.
7. Describe the design, operation and performance of biochemical techniques used for the analysis of samples for trace elements and vitamins.
8. Discuss the partnership of biochemical nutrition to other clinical specialisms in the investigation of nutritional disorders and patient care.

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. Perform the range of laboratory and point-of-care techniques used in the workplace to investigate nutritional disorders.
2. Perform the clinical and laboratory investigation and analysis and management of nutritional status.
3. Perform the clinical and laboratory investigation and analysis and management of digestion, absorption and pancreatic function.
4. Perform the clinical and laboratory investigation and analysis and management of disorders of iron metabolism and haem synthesis.
5. Perform laboratory techniques used in the workplace to investigate trace element and vitamin status.
6. Work in partnership with other clinical specialisms in the investigation and analysis of nutritional disorders.
7. Interpret and report on the results of clinical and laboratory investigation of nutrition in the correct clinical context.

Indicative Content
• Gastrointestinal disorders: physiology and biochemistry of digestion and absorption; malabsorption; pancreatitis (acute and chronic); coeliac disease; inflammatory bowel disease; anaemias; peptic ulcer disease; pyloric obstruction; carcinoid syndrome

• Gastrointestinal function testing: amylase; iron, ferritin, vitamin B12 and folate; calprotectin and lactoferrin, elastase; urea breath testing; gut hormones

• Protein energy balance and malnutrition; markers of nutritional status; assessment of nutritional status in elective, acute and chronic conditions, burns, multiple injury and sepsis; principles and practical nutritional support (enteral, parenteral)

• Trace elements in health and disease

• Methods of measurement of trace elements in biological samples; atomic absorption/emission; inductively coupled plasma mass spectrometry (ICP-MS)

• Vitamins in health and disease; syndromes of vitamin deficiency and excess

• Methods of measuring vitamins in biological samples

• Porphyrin metabolism, porphyrin measurement, systematic investigation of the porphyrias

This module will provide the trainee with the knowledge and understanding of basic pharmacology and the mechanism of action of drugs. They will understand pharmacokinetics and pharmacogenomics. They will optimise the use of commonly prescribed therapeutic drugs. They will be able to investigate the poisoned patient; screen for and confirm the presence of drugs of abuse. In the work-based module they will be expected to apply this knowledge as they learn to perform assays to assess therapeutic and toxic drugs using a range of methods and gain experience of the interpretation of results in a range of acute and chronic clinical conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the fundamental principles of pharmacokinetics.
2. Discuss the fate of foreign compounds in the human body and the biochemical basis of their desired and undesired actions.
3. Identify the appropriate sampling time and sample type for a range of therapeutically monitored drugs.
4. Describe the design, operation and performance of appropriate analytical methods for the detection and/or estimation of drugs or poisons.
5. Describe the major toxicity mechanisms in the human and explain the investigation of a suspected drug poisoning and related clinical conditions.

6. Describe and justify the medicolegal status of laboratory samples, including chain of custody principles.

7. Discuss and utilise information on liver and renal function, plus genetic information in the clinical interpretation of drug results.

8. Explain analytical sensitivity and specificity in the context of drug investigation.

9. Describe the partnership of biochemical drug investigation with other clinical specialisms in drug investigation and patient care.

### 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. Perform a range of laboratory techniques used in the workplace to monitor therapeutic drug concentrations.

2. Interpret the results of commonly used therapeutic drug monitoring (TDM) assays in the correct clinical context.

3. Perform a range of laboratory and point-of-care techniques to investigate drugs of abuse and other toxic substances in cases of acute poisoning, and understand the clinical context in which such techniques can be useful.

4. Decide the testing strategy for the investigation of patients taking drugs of abuse in the correct clinical and legal context.

5. Decide the testing strategy for the investigation of the poisoned patient in the correct clinical and forensic context.

6. Perform a range of pharmacogenetic tests.

7. Interpret and report the results of analyses of drug abuse, poisons and pharmacogenetic tests in the correct clinical or forensic context.

### Indicative Content

- Basic pharmacology, mechanism of action of drugs, drug metabolism
- Pharmacokinetics: half-life, dosage prediction
- Pharmacogenomics
- Therapeutic drug monitoring: digoxin, lithium, antiepileptics, theophylline, methotrexate, immunosuppressive drugs, antibiotics
- Metabolic effects of ethanol; alcohol excess
- Overdose: salicylate, paracetamol, barbiturate, tricyclic antidepressants
- Drug addiction: alcohol, opiates, amphetamines, benzodiazepines, cocaine, cannabis
- Poisoning: carbon monoxide, lead, mercury, aluminium, iron, paraquat, ethylene glycol, methanol and other organic alcohols, organophosphates
- Laboratory investigation of the unconscious or deceased poisoned patient
Laboratory methods for the measurement of therapeutic and toxic drugs from screening to confirmation

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Biochemistry
Year 3: CB-6
Pregnancy, Neonatal and Paediatric Clinical Biochemistry [10 credits]

This module will provide the trainee with the knowledge and understanding of the physiology of normal pregnancy and the impact on biochemical parameters. They will understand maternal and neonatal screening programmes and the investigation of neonates and children who may have inborn errors of metabolism. In the work-based module they will be expected to apply this knowledge as they perform assays to assess maternal, neonatal and paediatric status using a range of methods, and gain experience of the interpretation of results in a range of conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain and recognise the non-pathological changes in biochemical parameters during pregnancy and the need for specific reference ranges.
2. Discuss the clinical use of biochemical parameters in pregnancy and the interpretation of results in a range of conditions affecting mother and/or fetus.
3. Describe the design, operation and performance of biochemical and molecular techniques used in pregnancy and paediatric biochemistry.
4. Explain the requirements for antenatal and newborn screening programmes.
5. Describe the design, operation and performance of analytical techniques used in antenatal and newborn screening programmes.
6. Discuss the clinical and laboratory investigation of a neonate who is failing to thrive and an infant presenting with: (i) hypoglycaemia; (ii) hyperammonaemia, and (iii) jaundice.
7. Explain the need to convey complex biochemical information to inform the multidisciplinary team about cause and consequences of inborn errors of metabolism.

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. Perform the range of biochemical, point-of-care and molecular techniques used in the workplace to investigate pregnant women, neonates and infants.
2. Use reference ranges for the interpretation and reporting of results from pregnant women, neonates and infants.
3. Understand the UK antenatal and newborn screening programmes and the methodologies.
4. The clinical and laboratory investigation and management of neonates and infants with failure to thrive, hypoglycaemia, jaundice and hyperammonaemia.
5. The clinical and laboratory investigation and management of neonates and infants suspected of having an inborn error of metabolism.
6. Work in partnership with other clinical specialisms in the investigation of neonates and infants.
7. Interpret and report results of clinical and laboratory investigations relating to pregnancy, neonatology and paediatric clinical biochemistry in the correct clinical context.

Indicative Content
- **Pregnancy**: normal maternal and fetal physiology; complications, detection of abnormalities
- Implications of pregnancy on reference ranges
- Monitoring of at-risk pregnant patients with diabetes, thyroid disease, liver disease
- Testing in pregnancy for hydatidiform mole, ectopic pregnancy, choriocarcinoma
- Biochemical antenatal screening for Down Syndrome, neural tube defects and other fetal malformations
- **Neonates**: biochemical problems of the newborn, including fluid balance, hypoglycaemia, jaundice, liver disease, calcium homeostasis, hypomagnesaemia, hyperammonaemia; intersex disorders
- Implications of testing neonates: sample size, effect of matrix on methods, reference ranges
- Biochemical newborn screening: e.g. phenylketonuria; medium chain acyl CoA dehydrogenase and other inborn errors of metabolism; hypothyroidism; cystic fibrosis, sickle cell disease
- **Childhood**: hypoglycaemia; lactic acidosis; hyperammonaemia; calcium and phosphate disorders; Reye’s syndrome; precocious puberty; delayed puberty
- Inborn errors of metabolism: principles of investigation; quantitative and qualitative enzyme abnormalities; disorders of amino acids, organic acids, mucopolysaccharides, peroxisomes, urea cycle, purines and pyrimidines, mitochondrial and lysosomal disorders
- Methodology for biochemical investigation of neonates and children, including chromatography tandem mass spectrometry and molecular diagnostics
## Section 13: MSc Clinical Science Specialist Modules for Clinical Immunology

<table>
<thead>
<tr>
<th></th>
<th>Module Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
</tr>
<tr>
<td>Specialist Modules</td>
<td>CI-4 Hypersensitivity and Allergy [10]</td>
</tr>
<tr>
<td></td>
<td>CI-5 Haematological Malignancies and Transplantation [10]</td>
</tr>
<tr>
<td></td>
<td>CI-6 Autoimmunity [10]</td>
</tr>
<tr>
<td></td>
<td>CI-Res Research Project in Immunology [30]</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
<td></td>
</tr>
<tr>
<td>Specialist Modules</td>
<td>CI-2 Immunology and Infection [10]</td>
</tr>
<tr>
<td></td>
<td>CI-3 Immunodeficiency and Immunotherapy [10]</td>
</tr>
<tr>
<td></td>
<td>CI-Res Research Project in Immunology [30]</td>
</tr>
<tr>
<td><strong>Year 1</strong></td>
<td></td>
</tr>
<tr>
<td>Core Modules</td>
<td>Introduction to Healthcare Science, Professional Practice and Clinical Leadership [20]</td>
</tr>
<tr>
<td></td>
<td>Introduction to Blood Sciences Underpinning knowledge for rotational elements and integrated professional practice [40]</td>
</tr>
</tbody>
</table>

- **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
These modules provide the trainees in Clinical Immunology and Histocompatibility and Immunogenetics with the knowledge that underpins the specialist modules in Clinical Immunology, and provide trainees with the knowledge and understanding that underpins and is applied to work-based learning.

This module will provide the trainee with knowledge, understanding and clinical significance of immunity as applied to infection and cancer. The trainee will become familiar with methods and strategies to investigate immunity and gain experience of the interpretation of patient results in a variety of clinical settings.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Discuss the role of the immune system in defence against infection.
2. Discuss the role of the immune system in cancer and malignancy.
3. Describe the design, operation and performance of the tests and assays used to investigate the immune system in defence against infection.
4. Describe the design, operation and performance of the tests and assays used to investigate the immune system in cancer, particularly in haematological malignancies.
5. Describe the partnership between clinical immunology and other clinical specialisms in the investigation of the immune system in infection and haematological malignancy and patient care.

**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 immunology tests to investigate the role of the immune system against infection.
2. Undertake clinical and laboratory investigation of the immune system relating to defence against infection.
3. Select and perform immunology tests to investigate the role of the immune system against infection.
Interpret and report clinical immunological tests in the correct clinical context.
Work in partnership with other clinical specialisms to investigate the immune system in infection.

Indicative Content
- Microbial immunity
  - Inflammation (mediators; acute inflammatory response; ongoing inflammatory processes; regulation of inflammation; chronic inflammatory responses)
  - Viral infections (immune defences; viral counter defences; human immunodeficiency virus and autoimmune deficiency syndromes [AIDS])
  - Bacterial infections (immune defences; bacterial counter defences)
  - Parasite infections (immune defences; parasite counter defences)
  - Fungal infections (immune defences; fungal counter defences)
  - Immunisation and vaccination
  - Secondary immunodeficiency of infection
- Cancer immunity
  - Tumour antigens (virally controlled antigens; silent antigens; mutant antigens; differentiation antigens; major histocompatibility complex [MHC] antigens)
  - Innate immune responses (macrophages; natural killer [NK] cells)
  - Acquired immune responses (cytotoxic T cells)
  - Tumour counter defence mechanisms
  - Cancer immunotherapy (cytokines; monoclonal antibodies; antibody dependent cell-mediated cytotoxicity [ADCC]; immunisation; tumour vaccines)
  - Immunological diagnosis of cancers (immunofluorescence; immunogenetics; tumour markers)
  - Secondary immunodeficiency

This module will provide the trainee with knowledge and understanding of the causes of immunodeficiency. They will understand the clinical presentation and investigation of a range of immunodeficient conditions and the principles and practice of immunotherapy. They will become familiar with methods and strategies to investigate immunodeficiency and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding
On successful completion of this module the trainee will:
1. Discuss the clinical implications of immunodeficiency and the primary and secondary causes of immunodeficiency.
2. Explain the role of the humoral and cellular components of the immune system in immunodeficiency.
3. Describe the design, operation and performance of laboratory tests and assays used to investigate and define immunodeficiency.
4. Explain the principles of immunotherapy.
5. Describe and monitor the impact of immunotherapeutic treatments.
6. Discuss and justify appropriate immunotherapeutic strategies/treatment regimens for patients with a range of primary and secondary immunodeficiencies.
7. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of immunodeficiency and immunotherapy and patient care.

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 immunology tests for the diagnosis and management of immunodeficiency and monitoring of immunotherapy.
2. Perform clinical and laboratory investigation of immunodeficiency.
3. Interpret and report results of investigation of immunodeficiency in the correct clinical context.
4. Apply immunotherapeutic strategies for inpatients with a range of primary and secondary immunodeficiencies.
5. Work in partnership with other clinical specialisms in the investigation of immunodeficiency and immunotherapy.

Indicative Content

- Assessing immune function (T lymphocytes; B lymphocytes; phagocytes; complement)
- Deficiencies of innate immunity (phagocytic cell defects; leukocyte adhesion defects; complement system defects)
- B lymphocyte deficiencies (X-linked agammaglobulinaemias; selective IgA deficiency; IgG subclass deficiency; common variable immunodeficiency; transient hypogammaglobulinaemia of infancy; selective specific antibody deficiencies)
- T lymphocyte deficiencies (Di George syndrome; Ommen’s syndrome; bare lymphocyte syndrome; X-linked hyper IgM syndrome; severe T cell deficiencies [X-linked recessive form; adenosine deaminase (ADA) deficiency; purine nucleoside phosphorylase (PNP) deficiency])
- Combined T and B cell defects
• Severe combined immunodeficiency (SCID) (autosomal recessive SCID; T cell receptor immunodeficiency; MHC Class II deficiency; IL-2 production defect)
• Wiskott-Aldrich syndrome
• Secondary immunodeficiencies (iatrogenic; neoplasia; infection)
• Cytokine defects
• Human immunodeficiency virus (HIV) and AIDS
  • Pathogenesis of HIV infection
  • Epidemiology, prevalence and modes of transmission
  • Laboratory abnormalities in HIV infection
  • Management of HIV infection (drug therapies; vaccines)
• Immunotherapy
  • Antibodies as immunosuppressive agents (plasmapheresis and plasma exchange; monoclonal antibody therapy; generation of antibodies; ‘magic bullet’ therapy)
  • Immunosuppressive drugs (corticosteroids; cyclosporin and tacrolimus; other anti-inflammatory agents)
  • Other immunosuppressive agents (X-irradiation; ultraviolet light)
  • Cytokines and anti-cytokines (interleukin-1; interleukin-2; interferons; tumour necrosis factors [TNF]; Th1/Th2 balance)
  • Immune modulation by intravenous immunoglobulins
  • Immune potentiation (hormones; cytokine therapy; gene therapy)
  • Other uses of monoclonal antibodies
  • Stress and the immune system (psycho-neuro-endocrine-immune pathway)
  • Immunisation against infection (adjuvants; routine immunisations; travel immunisations; passive immunisation; new vaccines)
  • Cancer immunotherapy
  • Novel approaches to autoimmune disease (T cell vaccines; oral tolerance)
  • Other approaches (lymphocyte vaccination; blocking T cell-adenomatous polyposis coli [APC] interactions; gene repair; patient specific amplification of cytotoxic cells; stem cell therapies)

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Immunology  
**Years 2 and 3:** CI-Res  
**Research Project in Clinical Immunology**  
[60 credits]

The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in a specialism of healthcare science. The research project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be
designed to take into account the research training required by individual trainees and the needs of the department in which the research is to be conducted.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

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

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

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

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

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology and Histocompatibility and Immunogenetics
Year 3: CI-4
Hypersensitivity and Allergy
[10 credits]

This module will provide the trainee with knowledge and understanding of the mechanism of hypersensitivity and allergy. They will understand the clinical presentation and investigation of a range of conditions associated with hypersensitivity and allergy. They will become familiar with methods and strategies to investigate hypersensitivity and allergy and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Define and explain ‘atopy’ and the factors involved in the development of atopic disease.
2. Define and explain allergy, distinguishing it from hypersensitivity.
3. Explain and distinguish between the four types of hypersensitivity.
4. Explain the production of immunoglobulin E (IgE) by B cells in response to allergen.
5. Explain how IgE triggers mast cells to deregulate and describe the clinical features of mast cell degranulation in the allergic patient.
6. Discuss the important features of allergic rhinitis, atopic eczema and anaphylaxis.
7. Describe the design, operation and performance of hypersensitivity skin testing, including contraindications, limitations and precautions to be taken.
8. Describe the design, operation, use and limitations of immunology laboratory tests for specific IgE.
9. Discuss the important causes of and explain the mechanism of allergic
contact dermatitis.

10. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of hypersensitivity and allergy and patient care.

### 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 appropriate methods to investigate hypersensitivity and immunology laboratory tests for specific IgE.
2. Perform clinical and laboratory investigation of hypersensitivity and allergy.
3. Interpret and report results of investigations of hypersensitivity and allergy in the correct clinical context.
4. Work in partnership with other clinical specialisms in the investigation of hypersensitivity and allergy.

### Indicative Content

- **Type I Immediate hypersensitivity**
  - Pathogenesis
  - Allergic diseases (asthma; allergic rhinitis; allergic eczema; urticaria)
  - Anaphylaxis
  - Desensitisation
- **Type II Antibody-dependent cytotoxic hypersensitivity**
  - Organ-specific autoimmune diseases
  - Autoimmune cytopenias
  - Haemolytic disease of the newborn
- **Type III Immune complex-mediated hypersensitivity**
  - Serum sickness
  - Allergic alveolitis
  - Lepromatous leprosy
  - Systemic lupus erythematosus (SLE)
  - Cutaneous vasculitis
  - Arthus reaction
- **Type IV Delayed cell-mediated hypersensitivity**
  - Contact hypersensitivity
  - Tuberculous reactions
  - Granulomas
  - Graft rejection and graft versus host disease (GVHD)
- **Type V Stimulatory hypersensitivity**
  - Autoantibodies against cell receptors (thyroid stimulatory autoantibodies)
Division: Life Sciences  
Theme: Blood Sciences  
Specialism: Clinical Immunology and Histocompatibility and Immunogenetics  
Year 3: CI-5  
Haematological Malignancies and Transplantation  
[10 credits]

This module will provide the trainee with knowledge and understanding of the pathophysiology, clinical presentation and management of patients with haematological malignancies, transplantation and appropriate investigations. In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the classification, aetiology and genetics of haematological malignancy.
2. Describe the design, operation and performance of laboratory and molecular techniques used in the investigation and management of haematological malignancy.
3. Discuss the principles of bone marrow and stem cell harvests and their role in transplantation programmes.
4. Discuss the principles and mechanisms of chemotherapy, immunotherapy and radiotherapy and their use in haematological malignancy.
5. Explain the importance and implementation of national (e.g. NICE) guidance on the diagnosis and management of haematological cancer.
6. Discuss the importance of integrated diagnosis of haematological malignancy.
7. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy and patient care.

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 and perform laboratory tests for haematological malignancies and data analysis.
2. Undertake the clinical laboratory work-up of patients awaiting haemopoietic stem cell transplantation.
3. Interpret results of investigations for haematological malignancies and transplantation in the correct clinical context.
4. Work in partnership with other clinical specialisms in the investigation of haematological malignancies and transplantation.

Indicative Content
Current concepts on the aetiology, pathogenesis and molecular mechanisms involved in
- Myeloid malignancy
- Lymphoid leukaemia
- Lymphoma
- Myeloma and plasma cell disorders
- Myelodysplastic syndromes
- Diagnosis and management of the above
- Myeloproliferative disorders and their diagnosis and management
- Bone marrow failure syndromes
- Blood and bone marrow transplantation regimens
- Principles of chemo- and radiotherapy and the rationale behind Medical Research Council (MRC) acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL) trials
- Survival rates in haematological malignancy
- Internal quality control (IQC) and external quality assessment (EQA) in haemato-oncology
- BCSH guidelines in haemato-oncology; NICE improved outcome guidance

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology
Year 3: CI-6
Autoimmunity
[10 credits]

This module will provide the trainee with knowledge and understanding of the mechanism of autoimmunity. They will understand the clinical presentation and investigation of a range of autoimmune disease. They will become familiar with methods and strategies to investigate autoimmunity and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the causes of autoimmune disease.
2. Discuss and justify the strategies and methods to distinguish autoimmunity from autoimmune disease.
3. Explain the role of autoantibodies and autoimmune disease.
4. Explain the role of autoreactive T cells and autoimmune disease.
5. Discuss and justify the investigation and management of autoimmune disease.
6. Describe the design, operation and performance of laboratory techniques for the investigation of autoimmune disease.
7. Describe the partnership between clinical immunology and other clinical specialism in the investigation of autoimmune disease and patient care.

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 immunology tests for the diagnosis and management of a range of autoimmune diseases.
2. Perform clinical and laboratory investigation of a range of autoimmune diseases.
3. Interpret and report results of investigation of autoimmune disease in the correct clinical context.
4. Work in partnership with other clinical specialisms in the investigation of autoimmune disease.

Indicative Content

- Spectrum and overlap of autoimmune diseases (multifactorial; genetic factors; hormonal factors; environmental factors)
- Autoreactivity
  - Countering immune regulatory mechanisms
  - Pathogenic effects (autoantibodies; autoreactive cells; immune complexes)
  - Diagnostic tests
- Vasculitis
- Rheumatic and connective tissue diseases
- Endocrine autoimmune diseases
- Liver diseases
- Gastrointestinal diseases
- Renal diseases
- Skin diseases
- Neurological diseases
## Section 14: MSc Clinical Science Specialist Modules for Haematology and Transfusion Science

<table>
<thead>
<tr>
<th>Year 3 Specialist Modules</th>
<th>HT-4 Haemostasis</th>
<th>HT-5 Haematological Malignancy</th>
<th>HT-6 Transfusion</th>
<th>HT-Res Research Project in Haematology and Transfusion Science</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[10]</td>
<td>[10]</td>
<td>[10]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 2 Specialist Modules</th>
<th>Research Methods</th>
<th>HT-2 Disorders of Red and White Blood Cells</th>
<th>HT-3 Core Transfusion</th>
<th>HT-Res Research Project in Haematology and Transfusion Science</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[10]</td>
<td>[10]</td>
<td>[10]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year 1 Core Modules</th>
<th>Introduction to Healthcare Science, Professional Practice and Clinical Leadership</th>
<th>Introduction to Blood Sciences Underpinning knowledge for rotational elements and integrated professional practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[20]</td>
<td>[40]</td>
</tr>
</tbody>
</table>

**Legend:**
- **Blue**: Generic Modules: Common to all divisions of healthcare science
- **Light Blue**: Division/Theme-Specific Modules: Common to a division or theme
- **Orange**: Specialist Modules: Specific to a specialism
These modules provide the trainee with the knowledge that underpins the specialist module in Haematology and Transfusion Science and provides trainees with the knowledge and understanding that underpins and is applied to work-based learning.

This module will provide the trainee with the knowledge and understanding of the pathophysiology and clinical presentation of a range of disorders associated with abnormalities of red cell, white cell and haemostatic parameters. In the work-based module they will be expected to apply this knowledge as they perform methods related to red cell, white cell and haemostatic function and gain experience of the interpretation of patient results in a variety of clinical settings.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Describe common dietary and acquired anaemias and hereditary red cell disorders.
2. Explain the molecular basis, presentation, diagnosis and management of haemoglobinopathies and thalassaemia.
3. Discuss and evaluate the principles and practice of the national screening programme for sickle cell disease and thalassaemia.
4. Discuss the diversity, investigation, diagnosis and clinical relevance of hereditary red cell disorders.
5. Explain the basis, investigation, diagnosis and clinical relevance of white cell disorders.
6. Describe primary and secondary haemostasis and control mechanisms in haemostasis.
7. Explain the factors that affect the sensitivity and specificity of tests of haemostasis.
8. Discuss the partnership of clinical haematology to other clinical specialisms in the investigation of haematological disorders and patient care.

### 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. Perform a range of laboratory and molecular techniques used in the workplace to investigate anaemia, red cell disorders.
2. Perform a range of laboratory and molecular techniques used in the workplace to investigate white cell disorders.
3. Identify appropriate clinical and laboratory investigations and outline the management of acquired and hereditary red cell disorders.
4. Identify appropriate clinical and laboratory investigations and outline the management of non-malignant white cell disorders.
5. Perform quality assurance and control tasks across the range of investigations associated with the investigation of red and white blood cell disorders.

**Indicative Content**

Have the knowledge and understanding of physiology and pathophysiology, its investigation and diagnosis as it applies to the specialism in the following:

- **Red cells**
  - Normal physiology and bone marrow production of red cells
  - Structure and synthesis of normal and abnormal haemoglobin
  - Classification of anaemias
  - Iron metabolism and effect of iron deficiency and overload on erythropoiesis
  - Vitamin B12 and folate metabolism and effect of deficiency on erythropoiesis
  - Hereditary and acquired haemolytic anaemia
  - Principles, scientific basis, range and selection of analytical procedures applied in the investigation of anaemia
  - Presentation and laboratory investigation of anaemia, including iron deficiency, megaloblastic, haemolytic and enzymeopathies
  - Clinical interpretation of diagnostic results, treatment strategies and management
  - Molecular basis of abnormal haemoglobins and thalassaemia syndromes
  - The national screening programme for sickle cell disease and thalassaemia
  - Phenotypic and genotypic laboratory methods
  - Diagnosis of red cell enzymopathies
  - IQC and EQA in red cell disorders
  - Abnormalities in adults and children
  - Clinical complications of red cell enzymopathies and haemoglobinopathies
  - British Committee for Standards in Haematology (BCSH) Guidelines relevant to red cell investigation

- **White cells**
  - Normal leucopoeisis
  - Normal structure and function of white cells
  - Granulocytes, monocytes and their benign disorders
  - Disorders of neutrophil and monocyte function
Causes of leukocytosis, monocytosis and neutropenia
Principles, scientific basis, range and selection of analytical procedures applied to the investigation of white cell disorders
Presentation and laboratory investigation of white cell disorders
Clinical interpretation of diagnostic results, treatment strategies and management
BCSH Guidelines relevant to these white cell disorders

- Haemostasis
  - Primary haemostasis, role in supporting normal haemostasis, including blood vessel structure and function; platelet structure and function
  - Role of von Willebrand factor (VWF) in the interaction between blood vessels and platelets
  - Secondary haemostasis, including coagulation factors, structure and function, feedback and control mechanisms, localisation of clot
  - Vitamin K metabolism in the synthesis of functioning coagulation factors
  - Cell-based models of haemostasis and the role of tissue factor
  - Natural inhibitors of coagulation
  - Fibrinolysis, including activation, inhibition and the breakdown mechanism, fibrin clearance and degradation products
  - Use and monitoring of anticoagulant therapy
  - BCSH Guidelines relevant to haemostasis

Division: Life Sciences
Theme: Blood Sciences
Specialism: Haematology and Transfusion Science
Year 2: HT-3
Core Transfusion
[10 credits]

This module will provide the trainee with an in-depth knowledge of blood groups and their clinical significance in transfusion medicine. It will also provide the knowledge and skills required to work at a basic level within the transfusion hospital laboratory, operating within regulatory requirements, and providing safe and compatible blood and components for patients.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the genetic basis of the major blood groups, and the significance of red cell antigens and antibodies in transfusion medicine.
2. Describe the design, operation and performance of pre-transfusion procedures and serological tests and their use to ensure provision of compatible blood for patients.
3. Discuss and justify the procedures and practices required to select and issue appropriate, blood, components and products for patients.
4. Explain and evaluate the principles of blood stock management, the need for full traceability and maintenance of the cold chain.
5. Discuss and justify the need to work within national guidelines for transfusion, (e.g. BCSH), applicable regulatory requirements (e.g. UK Blood Safety and Quality Regulations [BSQR]) and quality management systems in the hospital transfusion laboratory.

6. Describe the partnership between the hospital blood transfusion laboratory and other clinical specialisms in the transfusion process and patient care.

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. Perform routine pre-transfusion procedures and serological tests, correctly interpret results and investigate anomalies to ensure provision of compatible blood for patients.
2. Select and issue appropriate blood, components and products for patients with a wide range of clinical conditions, in routine and emergency settings.
3. Investigate suspected adverse reactions and events according to clinical presentation.
4. Manage blood stocks, including full traceability and maintenance of the cold chain.
5. Interpret and comply with national guidelines for transfusion, applicable regulatory requirements (e.g. Blood Safety and Quality Regulations) and quality management systems in the hospital transfusion laboratory.

Indicative Content

- Blood group systems, genes antigens, antibodies and their clinical significance in transfusion medicine
- Immunological basis of antibody-mediated red cell destruction
- Factors affecting antigen: antibody reactions in vitro and principles of serological tests
- Intra-operative autologous transfusion technologies
- Pre-transfusion testing protocols to establish compatibility
- IT systems, automation and security
- Indications for and administration of blood components
- Selection of components for patients with special requirements, e.g. sickle cell disease (SCD), neonates
- Transfusion support for transplant patients (bone marrow transplant [BMT], stem cell, solid organ)
- Appropriate use of blood and components
- Novel blood derivatives, therapeutics and their application
- Alternatives to transfusion
- Management of major haemorrhage
- Management of major incidents
- Management of transfusion reactions
The overall aim of this module, building on the Research Methods module, is for the trainee to undertake a research project that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in a specialism of healthcare science. The research project may span scientific or clinical research, translational research, operational and policy research, clinical education research, innovation, service development, service improvement, or supporting professional service users to meet the expected learning outcomes. Research projects should be designed to take into account the research training required by individual trainees and the needs of the department in which the research is to be conducted.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

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

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:
1. Design, plan and undertake a research project to test a hypothesis from conception to completion/archiving in accordance with ethical and research governance regulations drawing on expert advice where necessary and involving patients and service users.

2. Analyse the data using appropriate methods and statistical techniques, and interpret, critically discuss and draw conclusions from the data.

3. Prepare a written project that describes and critically evaluates the research project, clearly identifying the strengths and weaknesses.

4. Present a summary of the research project and outcome that conforms to the format of a typical scientific presentation at a national or international scientific meeting, responding to questions appropriately.

5. Prepare a summary of the research project suitable for non-specialist and lay audiences.

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

**Year 3 Specialist Practice**

<table>
<thead>
<tr>
<th>Division:</th>
<th>Life Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme:</td>
<td>Blood Sciences</td>
</tr>
<tr>
<td>Specialism:</td>
<td>Haematology and Transfusion Science</td>
</tr>
<tr>
<td>Year 3:</td>
<td>HT-4</td>
</tr>
<tr>
<td>Haemostasis</td>
<td>[10 credits]</td>
</tr>
</tbody>
</table>

This module will provide the trainee with the detailed knowledge and understanding of the pathophysiology and clinical presentation of a range of...
acquired and genetic bleeding disorders and thrombotic disorders. In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain congenital and acquired bleeding disorders.
2. Describe the design, operation and performance of laboratory, molecular and point-of-care techniques used in the investigation of bleeding disorders.
3. Discuss and justify the diagnosis and management of bleeding disorders.
4. Describe and evaluate the causes and risks, diagnosis and treatment options of thrombophilia.
5. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of bleeding disorders and patient care.

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 appropriate clinical and laboratory investigations for the investigation of haemostasis.
2. Perform the range of laboratory, molecular and point-of-care testing (POCT) techniques used in the workplace to diagnose and monitor treatment of bleeding disorders and thrombophilia.
3. Interpret and report results of investigations of haemostasis in the correct clinical context.

Indicative Content

- Hereditary and acquired primary and secondary bleeding disorders, including nature and sites of bleeding; risks associated with severity
- Hereditary and acquired thrombotic disorders, including structure and aetiology of thrombus formation; relative risk and environmental factors
- The genetic basis and functional defects of hereditary bleeding and thrombotic disorders
- Disseminated intravascular coagulation (DIC)
- Principles, scientific basis, range and selection of analytical procedures applied in the investigation of bleeding and thrombotic disorders
- Presentation and laboratory investigation of bleeding and thrombotic disorders, and BCSH guidelines relevant to this area
Clinical interpretation of diagnostic results, treatment strategies and management (including clotting factor replacement therapy; anticoagulant therapy; prophylaxis); family studies

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Haematology and Transfusion Science  
**Year 3:** HT-5  
**Haematological Malignancy**  
[10 credits]

This module will provide the trainee with knowledge and understanding of the pathophysiology, clinical presentation and management of patients with haematological malignancy. In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain the classification, aetiology and genetics of haematological malignancy.
2. Describe the design, operation and performance of laboratory and molecular techniques used in the investigation and management of haematological malignancy.
3. Discuss the principles of bone marrow and stem cell harvests and their role in transplantation programmes.
4. Discuss the principles and mechanisms of chemotherapy, immunotherapy and radiotherapy and their use in haematological malignancy.
5. Describe and justify the importance and implementation of national (e.g. NICE) guidance on the diagnosis and management of haematological cancer.
6. Describe and justify the importance of integrated diagnosis of haematological malignancy.
7. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy and patient care.

**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. Perform a range of laboratory and molecular testing techniques used in the workplace to diagnose and monitor treatment of haematological malignancy.

2. Perform laboratory investigations and outline the management of haematological malignancy in the correct clinical context, including the interpretation and reporting of results.

3. Interpret and comply with national and international guidance (e.g. NICE, WHO, BCSH) on the diagnosis and management of haematological cancer.

**Indicative Content**
Current concepts on the aetiology, pathogenesis and molecular mechanisms involved in
- Myeloid malignancy
- Lymphoid leukaemia
- Lymphoma
- Myeloma and plasma cell disorders
- Myelodysplastic syndromes
- Diagnosis and management of the above
- Myeloproliferative disorders and their diagnosis and management
- Bone marrow failure syndromes
- Blood and bone marrow transplantation regimes
- Principles of chemo- and radiotherapy and the rationale behind Medical Research Council (MRC) acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL) trials
- Survival rates in haematological malignancy
- IQC and EQA in haemato-oncology
- BCSH guidelines in haemato-oncology; NICE improved outcome guidance

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Haematology and Transfusion Science  
**Year 3:** HT-6

**Transfusion  
[10 credits]**

This module will provide the trainee with the knowledge and practical skills to resolve serological anomalies in pre-transfusion testing and to know when further referral is necessary. It will also enable them to undertake antenatal testing and procedures to prevent anti-D sensitisation of women with child-bearing potential. In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings. The module will also provide the trainee with an understanding of the principles and practice of blood transfusion in a blood services setting, and the relevance of these procedures in reducing transfusion risk and providing optimum component therapy for patients.

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

1. Explain the clinical and technical basis of blood grouping anomalies and how to resolve these to make safe blood group interpretations for patients and donors.
2. Discuss and evaluate the process involved in resolving complex red cell antibody cases using non-routine serological and molecular testing.
3. Describe the aetiology and classification of autoimmune haemolytic anaemias, and the testing required to provide effective transfusion support.
4. Describe algorithms for routine and non-routine antenatal testing, and the use of anti-D prophylaxis and fetal maternal hemorrhage (FMH) testing to prevent sensitisation to the D antigen.
5. Discuss and evaluate the role of the transfusion specialist in diagnosis, management and treatment of haemolytic disease of the fetus and newborn (HDFN).
6. Explain and justify the rationale behind the selection of immunohaematological tests for new and established donors and how the requirements for donor testing differ from those for patient testing.
7. Discuss methods for preparation of blood components and products, and the requirement to work in conformance with quality systems and legislation such as Good Manufacturing Practice (GMP).
8. Describe the design, operation and performance of assays for markers of transfusion-transmitted infections (TTI). Understand which additional tests are required for specific groups of donors, and the algorithms for confirming positive results and for deferral/reinstatement of donors, and the impact on blood safety.
9. Discuss donor issues, including donor selection, recruitment, motivation and care.
10. Explain the principles of bone marrow and stem cell transplant, histocompatibility and immunogenetics (H&I) testing and cord banking.

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. Troubleshoot serological tests, investigate patient and donor blood grouping anomalies, and make interpretations in clinical context.
2. Select, perform and interpret the results of non-routine additional tests to elucidate alloantibodies in complex cases (mixtures, high frequency, etc.), and liaise with clinicians and blood services regarding transfusion support.
3. Select and perform serological tests for differential diagnosis of autoimmune haemolytic anaemia (AIHA) and for provision of suitable blood for transfusion.
4. Use algorithms for routine and non-routine antenatal testing and the use of anti-D prophylaxis and fetomaternal haemorrhage (FMH) testing.
5. Select and perform tests to predict and monitor haemolytic disease of the fetus and newborn (HDFN), and provide appropriate transfusion therapy for the fetus and neonate.
6. Work with specialist blood transfusion services to provide safe transfusion support for patients and be able to inform clinicians on blood safety issues.

**Indicative Content**
- Strategies for resolution of complex antibody identification cases
- Causes and investigation of ABO and D typing anomalies
- Aetiology, classification, investigation and management of AIHA
- Aetiology and management of haemolytic disease of the fetus and newborn (HDFN)
- Routine antenatal testing and follow-up of cases with red cell antibodies
- FMH testing
- Molecular techniques for genotyping and antibody identification
- Principles of donor selection, recruitment, motivation, and care
- Blood collection, methods to prevent infection, and storage prior to processing
- Apheresis and use/management of specialist panels
- Mandatory and discretionary testing for transfusion-transmitted infections, and criteria for donor exclusion/reinstatement
- Principles of TTI assay methods, selection and validation
- Variant Creutzfeldt-Jacob disease (vCJD), emerging pathogens and pathogen reduction strategies
- Blood component production and quality control, and changes to blood and components on storage
- The national frozen blood bank and provision of rare red cells
- Fractionated products – types, storage and use
- Principles of bone marrow and stem cell transplantation
- Principles of testing for human leucocyte antigens (HLA), human platelet antigens (HPA) and neutrophil antigens/antibodies
- Principles of cord banking
## Section 15: MSc Clinical Science Specialist Modules for Histocompatibility and Immunogenetics

<table>
<thead>
<tr>
<th></th>
<th>Module Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 3</strong></td>
<td></td>
</tr>
<tr>
<td>Specialist</td>
<td>CI-4 Hypersensitivity and Allergy</td>
</tr>
<tr>
<td>Modules</td>
<td>CI-5 Haematological Malignancies and Transplantation</td>
</tr>
<tr>
<td></td>
<td>H&amp;I-6 Haematopoietic Stem Cell Transplantation</td>
</tr>
<tr>
<td></td>
<td>H&amp;I-Res Research Project in Histocompatibility and Immunogenetics</td>
</tr>
<tr>
<td>Year 2</td>
<td></td>
</tr>
<tr>
<td>Specialist</td>
<td>Research Methods</td>
</tr>
<tr>
<td>Modules</td>
<td>CI-3 Immunodeficiency and Immunotherapy</td>
</tr>
<tr>
<td></td>
<td>H&amp;I-2 Histocompatibility</td>
</tr>
<tr>
<td></td>
<td>H&amp;I-Res Research Project in Histocompatibility and Immunogenetics</td>
</tr>
<tr>
<td>Year 1</td>
<td></td>
</tr>
<tr>
<td>Core Modules</td>
<td>Introduction to Healthcare Science, Professional Practice and Clinical Leadership</td>
</tr>
<tr>
<td></td>
<td>Introduction to Blood Sciences</td>
</tr>
<tr>
<td></td>
<td>Underpinning knowledge for rotational elements and integrated professional practice</td>
</tr>
</tbody>
</table>

**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

Page | 81
STP MSc Blood Sciences v 1.0 for 2017/18 (Draft)
Introduction

Trainees in Histocompatibility and Immunogenetics will share three modules with trainees in Clinical Immunology and also complete two Histocompatibility and Immunogenetics specific modules as listed below:

- H&I-2: Histocompatibility
- CI-3: Immunodeficiency and Immunotherapy
- CI-4: Hypersensitivity and Allergy
- CI-5: Haematological Malignancies and Transplantation
- H&I-6 Haematopoietic Stem Cell Transplantation

This module will provide the trainee with knowledge and understanding of the scientific basis of organ transplantation. They will understand the clinical preparation of patients for organ transplantation and the principles and practice of immunogenetics. They will become familiar with methods that support transplantation and gain experience of the interpretation of patient results in a variety of clinical settings. The trainee should be based in or spend extended time in a histocompatibility and immunogenetics department.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the immunological barriers to solid organ and haematopoietic stem cell transplantation.
2. Describe the mechanisms of graft rejection and the relevance of pre-sensitisation.
3. Describe the mechanisms of current immunosuppressive therapies in the control of graft rejection.
4. Discuss the role of the histocompatibility and immunogenetics laboratory in the pre transplant work-up and post-transplant management of patients.
5. Describe the design, operation and performance of appropriate laboratory tests in support of HLA antibody identification and definition, HLA typing and data analysis.
6. Describe the design, operation and performance of appropriate laboratory tests in support of cross-matching for solid organ transplantation.
7. Describe the partnership between the histocompatibility and immunogenetics laboratory and other clinical specialisms in solid organ and haematopoietic stem cell transplantation and patient care.
See work-based learning guide

Indicative Content

- Histocompatibility antigens
  - Structure and function
  - Generation of polymorphism
  - Nomenclature
- Mechanisms of allograft rejection
  - Alloantigen recognition
  - Classification of rejection reactions
  - Graft versus host reactions
  - HLA typing
  - Pre-transplant sensitisation
- Immunosuppressive therapy
  - Drugs
  - Biological modifiers
  - NICE recommendations
  - Adverse effects of immunosuppressive therapies
- Clinical transplantation
  - Renal transplantation (selection of recipient and donor; post-transplantation period; clinical rejection; immunopathology of rejection; graft survival; complications)
  - Other types of organ transplantation (liver; heart; lung; pancreas; pancreatic islets; skin; cornea)
  - Haematopoietic stem cell transplantation (indications and selection of patients; donor–recipient matching requirements; management; complications and prevention; results and prognosis; sources of stem cells for transplantation; stem cell transplantation for non-malignant indications)

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology and Histocompatibility and Immunogenetics
Year 2: CI-3
Immunodeficiency and Immunotherapy
[10 credits]

This module will provide the trainee with knowledge and understanding of the causes of immunodeficiency. They will understand the clinical presentation and investigation of a range of immunodeficient conditions and the principles and practice of immunotherapy. They will become familiar with methods and strategies to investigate immunodeficiency and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:
1. Discuss the clinical implications of immunodeficiency and the primary and secondary causes of immunodeficiency.
2. Explain the role of the humoral and cellular components of the immune system in immunodeficiency.
3. Describe the design, operation and performance of laboratory tests and assays used to investigate and define immunodeficiency.
4. Explain the principles of immunotherapy.
5. Describe and monitor the impact of immunotherapeutic treatments.
6. Discuss and justify appropriate immunotherapeutic strategies/treatment regimens for patients with a range of primary and secondary immunodeficiencies.
7. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of immunodeficiency and immunotherapy and patient care.

**Learning Outcomes: Associated Work-based Learning**

**See work-based learning guide**

**Indicative Content**

- Assessing immune function (T lymphocytes; B lymphocytes; phagocytes; complement)
- Deficiencies of innate immunity (phagocytic cell defects; leukocyte adhesion defects; complement system defects)
- B lymphocyte deficiencies (X-linked agammaglobulinaemias; selective IgA deficiency; IgG subclass deficiency; common variable immunodeficiency; transient hypogammaglobulinaemia of infancy; selective specific antibody deficiencies)
- T lymphocyte deficiencies (Di George syndrome; Ommen's syndrome; bare lymphocyte syndrome; X-linked hyper IgM syndrome; severe T cell deficiencies [X-linked recessive form; adenosine deaminase (ADA) deficiency; purine nucleoside phosphorylase (PNP) deficiency])
- Combined T and B cell defects
  - Severe combined immunodeficiency (SCID) (autosomal recessive SCID; T cell receptor immunodeficiency; MHC Class II deficiency; IL-2 production defect)
  - Wiskott-Aldrich syndrome
- Secondary immunodeficiencies (iatrogenic; neoplasia; infection)
- Cytokine defects
- Human immunodeficiency virus (HIV) and AIDS
  - Pathogenesis of HIV infection
  - Epidemiology, prevalence and modes of transmission
  - Laboratory abnormalities in HIV infection
  - Management of HIV infection (drug therapies; vaccines)
- Immunotherapy
  - Antibodies as immunosuppressive agents (plasmapheresis and plasma exchange; monoclonal antibody therapy; generation of antibodies; ‘magic bullet’ therapy)
Immunosuppressive drugs (corticosteroids; cyclosporin and tacrolimus; other anti-inflammatory agents)
- Other immunosuppressive agents (X-irradiation; ultraviolet light)
- Cytokines and anti-cytokines (interleukin-1; interleukin-2; interferons; tumour necrosis factors [TNF]; Th1/Th2 balance)
- Immune modulation by intravenous immunoglobulins
- Immune potentiation (hormones; cytokine therapy; gene therapy)
- Other uses of monoclonal antibodies
- Stress and the immune system (psycho-neuro-endocrino-immune pathway)
- Immunisation against infection (adjuvants; routine immunisations; travel immunisations; passive immunisation; new vaccines)
- Cancer immunotherapy
- Novel approaches to autoimmune disease (T cell vaccines; oral tolerance)
- Other approaches (lymphocyte vaccination; blocking T cell-adenomatous polyposis coli [APC] interactions; gene repair; patient specific amplification of cytotoxic cells; stem cell therapies)

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology and Histocompatibility and Immunogenetics
Year 3: CI-4
Hypersensitivity and Allergy

[10 credits]

This module will provide the trainee with knowledge and understanding of the mechanism of hypersensitivity and allergy. They will understand the clinical presentation and investigation of a range of conditions associated with hypersensitivity and allergy. They will become familiar with methods and strategies to investigate hypersensitivity and allergy and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Define and explain 'atopy' and the factors involved in the development of atopic disease.
2. Define and explain allergy, distinguishing it from hypersensitivity.
3. Explain and distinguish between the four types of hypersensitivity.
4. Explain the production of immunoglobulin E (IgE) by B cells in response to allergen.
5. Explain how IgE triggers mast cells to deregulate and describe the clinical features of mast cell degranulation in the allergic patient.
6. Discuss the important features of allergic rhinitis, atopic eczema and anaphylaxis.
7. Describe the design, operation and performance of hypersensitivity skin testing, including contraindications, limitations and precautions to be taken.
8. Describe the design, operation, use and limitations of immunology laboratory tests for specific IgE.
9. Discuss the important causes of and explain the mechanism of allergic contact dermatitis.
10. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of hypersensitivity and allergy and patient care.

**Learning Outcomes: Associated Work-based Learning**

**See work-based learning guide**

**Indicative Content**

- **Type I Immediate hypersensitivity**
  - Pathogenesis
  - Allergic diseases (asthma; allergic rhinitis; allergic eczema; urticaria)
  - Anaphylaxis
  - Desensitisation
- **Type II Antibody-dependent cytotoxic hypersensitivity**
  - Organ-specific autoimmune diseases
  - Autoimmune cytopenias
  - Haemolytic disease of the newborn
- **Type III Immune complex-mediated hypersensitivity**
  - Serum sickness
  - Allergic alveolitis
  - Lepromatous leprosy
  - Systemic lupus erythematosus (SLE)
  - Cutaneous vasculitis
  - Arthus reaction
- **Type IV Delayed cell-mediated hypersensitivity**
  - Contact hypersensitivity
  - Tuberculous reactions
  - Granulomas
  - Graft rejection and graft versus host disease (GVHD)
- **Type V Stimulatory hypersensitivity**
  - Autoantibodies against cell receptors (thyroid stimulatory autoantibodies)

**Division:** Life Sciences  
**Theme:** Blood Sciences  
**Specialism:** Clinical Immunology and Histocompatibility and Immunogenetics  
**Year 3:** CI-5  
**Haematological Malignancies and Transplantation**  
[10 credits]

This module will provide the trainee with knowledge and understanding of the pathophysiology, clinical presentation and management of patients with haematological malignancies, transplantation and appropriate investigations.
In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

### Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

8. Explain the classification, aetiology and genetics of haematological malignancy.
9. Describe the design, operation and performance of laboratory and molecular techniques used in the investigation and management of haematological malignancy.
10. Discuss the principles of bone marrow and stem cell harvests and their role in transplantation programmes.
11. Discuss the principles and mechanisms of chemotherapy, immunotherapy and radiotherapy and their use in haematological malignancy.
12. Explain the importance and implementation of national (e.g. NICE) guidance on the diagnosis and management of haematological cancer.
13. Discuss the importance of integrated diagnosis of haematological malignancy.
14. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy and patient care.

### Learning Outcomes: Associated Work-based Learning

See work-based learning guide

### Indicative Content

Current concepts on the aetiology, pathogenesis and molecular mechanisms involved in

- Myeloid malignancy
- Lymphoid leukaemia
- Lymphoma
- Myeloma and plasma cell disorders
- Myelodysplastic syndromes
- Diagnosis and management of the above
- Myeloproliferative disorders and their diagnosis and management
- Bone marrow failure syndromes
- Blood and bone marrow transplantation regimens
- Principles of chemo- and radiotherapy and the rationale behind Medical Research Council (MRC) acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL) trials
- Survival rates in haematological malignancy
- Internal quality control (IQC) and external quality assessment (EQA) in haematology-oncology
- BCSH guidelines in haematology-oncology; NICE improved outcome guidance
This module will provide the trainee with a knowledge and understanding of stem cell donation, testing, harvesting and monitoring. They will understand a range of clinical conditions associated with stem cell transplantation requirements. They will gain experience of HLA typing in the matching of donors and suitable recipients. In the work-based module they will be expected to apply this knowledge as they learn to perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

**Learning Outcomes: Knowledge and Understanding**

On successful completion of this module the trainee will:

1. Explain the role of HSCT in the treatment of various haematopoietic disorders.
2. Know the nomenclature of the HLA system and discuss its role in the selection of donors for HSCT.
3. Describe the design, operation and performance of HLA typing methods for HSCT according to current guidelines.
4. Explain the principles of post-transplant monitoring and its role in patient management.
5. Describe the partnership between histocompatibility and immunogenetics and other clinical specialisms in the investigation of HSCT and patient care.

**Learning Outcomes: Associated Work-based Learning**

See work-based learning guide

**Indicative Content**

- Principles of HSCT
- HLA genetics and nomenclature
- Stem cell sources
- Principles of donor selection
- Pre-transplant work-up
- Compatibility testing
- Stem cell registries – Bone Marrow Donors Worldwide (BMDW), Anthony Nolan Trust (ANT), Worldwide Network for Blood and Marrow Transplantation (NetCord)
- Principles of post-transplant monitoring
• Graft versus host disease and graft versus leukaemia
• Legislation: Joint Accreditation Committee – ISCT & EBMT (JACIE),
Human Tissue Authority (HTA), European Federation for Immunogenetics
(EFI), Foundation for the Accreditation of Cellular Therapy (FACT)
Appendix 1: Contributor List

Members of the STP Blood Sciences curriculum (MSc and Work-based Learning Guide) from 2009

Production of this STP been coordinated by the Modernising Scientific Careers team and the National School of Healthcare Science working with NHS and Higher Education colleagues and patients including:

Annie Armston  Southampton University Hospital Trust
David Baty  Ninewells Hospital, Dundee
Jennie Bell  Birmingham Women's Hospital
Michelle Bishop  HEE Genomics Education Programme
Frances Boa  St George’s Healthcare NHS Trust, London
Geoff Bosson  University of Northumbria, Newcastle upon Tyne
Laura Boyes  Birmingham Women’s NHS Foundation Trust
Anne Brookes  National Blood Service (Retired)
Kathryn Brownbill  Royal Blackburn Hospital
George Burghel  Central Manchester University Hospitals NHS Foundation Trust
David Cameron  NHS Greater Glasgow & Clyde
Rachel Carling  St Thomas’ Hospital, London
Peter Charles  Imperial College Healthcare NHS Trust, London
Sean Conlon  Belfast Health and Social Care Trust
Alistair Crockard  Belfast Health and Social Care Trust
Gareth Cross  Nottingham City Hospital
Anne Dalton  Sheffield Children’s NHS Foundation Trust
Sue Davey  NHS Blood and Transplant
Val Davison  National School of Healthcare Science and Birmingham Women’s Hospital
Tricia Dening-Kendall  Southmead Hospital, Bristol
Mandy Donaldson  Imperial College Healthcare NHS Trust, London
Ruth Evans  NHS Blood and Transplant
Berne Ferry  The Churchill Hospital, Oxford
Bob Flanagan  King's College Hospital, London
Danielle Freedman  Luton & Dunstable NHS Trust
Lorraine Gaunt  St Mary’s Hospital, Manchester
Georgina Hall  Manchester Centre for Genomic Medicine
Stephen Halloran  Royal Surrey County Hospital, Guildford
Don Henderson  Imperial College Healthcare NHS Trust, London
Elizabeth Hodges  Southampton University Hospitals NHS Trust
Lowri Hughes  Birmingham Women’s NHS Foundation Trust
Tim James  John Radcliffe Hospital, Oxford
Ian Jennings  UK NEQAS, Sheffield
Helen Jolley  Manchester Centre for Genomic Medicine
Betty Kyle  NHS Lanarkshire
Abirami Koneswaran  St George’s Healthcare NHS Trust, London
John Lord  Royal Blackburn Hospital
Gordon Lowther  Southern General Hospital, Glasgow
Marion McAllister  
Cardiff University

Marion Macey  
Barts and the London NHS Trust

Rhona MacLeod  
Manchester Centre for Genomic Medicine

Gwyn McCreanor  
Kettering General Hospital

Anna Middleton  
Wellcome Trust Sanger Institute, Cambridge

Andy Miller  
NHS London

Bridget Montague  
Leeds Teaching Hospitals NHS Trust

Jane Needham  
Basingstoke and Hampshire Foundation Trust

Sheila O'Connor  
Leeds Teaching Hospitals NHS Trust

Michael Palmer  
Kings Mill Hospital, Mansfield

Christine Patch  
‘Guy’s and St Thomas’ NHS Foundation Trust Hospital

Joan Peel  
Midlands and East Strategic Health Authority

Dan Pelling  
Imperial College Healthcare NHS Trust, London

Les Perry  
Barts and The London NHS Trust

Neil Porter  
Yorkshire and Humber SHA

Kay Poulton  
Central Manchester Foundation Trust

Tracey Rees  
Welsh Blood Service

David Ricketts  
North Middlesex Hospitals NHS Trust

Eileen Roberts  
Southmead Hospital, Bristol

Amanda Robson  
Manchester Royal Infirmary

Gill Rumsby  
University College Hospital London

Deborah Sage  
NHS Blood and Transplant, Tooting Centre, London

Marion Scott  
Southmead Hospital, Bristol

Anneke Seller  
Churchill Hospital, Oxford

Ruhena Sergeant  
Imperial College Healthcare NHS Trust

Jo Sheldon  
St George’s Healthcare NHS Trust, London

Robert Simpson  
Queen Alexandra Hospital, Portsmouth

Heather Skirton  
Plymouth University

Paul Sinnott  
Barts and The London NHS Trust

John Stevens  
Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust

Dan Smith  
John Radcliffe Hospital, Oxford

Dave Stockwell  
Morriston Hospital, Swansea

Alison Taylor-Beading  
Great Ormond Street NHS Foundation Trust

Julian Waldron  
University Hospitals North Staffordshire

Anthony Warrens  
Imperial College Healthcare NHS Trust, London

Jonathan Waters  
Great Ormond Street Hospital for Children, London

Melanie Watson  
Bristol Royal Infirmary

Ian Watson  
Aintree Hospitals, Liverpool

Stephen Whiting  
Royal Free Hospital, London

Jenny White  
West Hertfordshire Hospitals NHS Trust

David Wilson  
Raigmore Hospital, Inverness

Eileen Williams  
Southmead Hospital, Bristol

Professional bodies and societies were invited to review this curriculum and their feedback has shaped the final publication:

Association for Clinical Biochemistry (Clinical Immunology)
Association for Clinical Cytogenetics
The National School of Healthcare Science Themed Board reviewed the MSc Clinical Science (Blood Sciences) Curriculum on 10 January 2013 and its feedback has also shaped the final publication.

**Modernising Scientific Careers Professional Advisors**
Dr Graham Beastall
Ms Nicky Fleming
Mr Barry Hodgson

**National School of Healthcare Science Professional Leads**
Ms Nicky Fleming
Dr Barbara Lloyd
Dr Graham Wilson
Appendix 2: Programme Amendments

This section lists the programme amendments following first publication.

Amendments – February 2012

The Association for Clinical Biochemistry (Clinical Immunology) requested that the following changes were made to the 2010/11 edition of the Clinical Immunology Year 2 specialism sections of the MSc Clinical Sciences (Blood Sciences). The MSC team have made the changes requested by the professional body, detailed below and re-issued as MSc Clinical Sciences (Blood Sciences) 2010-11 v2 (see footer).

Page 56 section 6.1 Year 2 Specialist Practice for Clinical Immunology

Year 2: C1-2: Immunity: Implications for Infection, for Cancer and for Pregnancy

Clinical Immunology does not deal specifically with pregnancy and therefore:

- The learning outcomes in the Knowledge and Understanding and Associated work-based curriculum have been revised. All learning outcomes associated with pregnancy have been removed.
- The title of the Module has been updated and is now Year 2: C1-2: Immunity: Implications for Infection and for Cancer

Page 59 section 6.1 Year 2 Specialist Practice for Clinical Immunology

Year 2: C1-3: Autoimmunity

Clinical Immunology does not deal specifically with pregnancy and therefore:

- The learning outcomes in the Knowledge and Understanding and Associated work-based curriculum have been revised. All learning outcomes associated with pregnancy have been removed.

All other content in this curriculum remains unchanged.

The amended version is titled MSc Blood Sciences 2010-11 v2 (see footer).

For any queries regarding this change please email: nshcs@wm.hee.nhs.uk
Amendments – November 2012

The Association for Clinical Biochemistry (Clinical Immunology) and the British Society for Histocompatibility and Immunogenetics jointly requested that the following changes were made to the 2010/11 edition of the Clinical Immunology and the Histocompatibility and Immunogenetics Years 2 and 3 specialism sections of the MSc Clinical Sciences (Blood Sciences). The MSC team have made the changes requested by the professional bodies, detailed below in this updated version of the MSc Clinical Sciences (Blood Sciences) 2010-11 version 3 (see footer).

The changes result from experience of using the 2010-11 MSc. It was agreed by both professional bodies that the original content of the syllabus did not adequately reflect the latest learning in transplantation that is required by trainees in this in Clinical Immunology and Histocompatibility and Immunogenetics. In outline the changes comprise:

1. The preparation of a new module that is common to both curricula and which replaces two different modules (one from each curriculum).
2. The change of title for one module in the Histocompatibility and Immunogenetics curriculum.
3. A change of order of the modules to ensure that the three common modules are at the same stage in each of the two curricula.

The detailed changes are given below. The changes to the Clinical Immunology syllabus carry into the Histocompatibility and Immunogenetics syllabus except where indicated. For clarity all Clinical Immunology modules have been coded ‘CI’ and all Histocompatibility and Immunogenetics modules have been coded ‘HI’. Commonality between the two syllabi is maintained with modules CI-3/HI-3; CI-4/HI-4; and CI-5/HI-5 being identical.

Clinical Immunology Curriculum

Page 58 section 6.1 Year 2 Specialist Practice for Clinical Immunology

The module entitled ‘Immunodeficiency and Immunotherapy’ has been renumbered as CI-3 (previously CI-5). The earlier introduction of this module into the syllabus is seen as a sensible move.

Page 66 section 6.3 Year 3 Specialist Practice for Clinical Immunology

The new module CI-5 entitled ‘Haematological Malignancy and Transplantation’ has been introduced as a replacement for the previous module CI-6 entitled ‘Transplantation’. This better reflects the work of trainees in supporting the investigation and treatment of haematological malignancy.

Page 68 section 6.3 Year 3 Specialist Practice for Clinical Immunology

The module entitled ‘Autoimmunity’ has been renumbered as CI-6 (previously CI-3). This is a standalone module and there is no difficulty in repositioning it as the final specialist module for Clinical Immunology.

Histocompatibility and Immunogenetics Curriculum
Page 94

STP MSc Blood Sciences v 1.0 for 2017/18 (Draft)
Page 71 section 6.5 Year 2 Specialist Practice for Histocompatibility and Immunogenetics

Module HI-2 has been renamed ‘Histocompatibility’ and given a new number. This module was previously CI-6 and entitled ‘Transplantation’. The module has been removed from the Clinical Immunology syllabus (see above). The module focuses on histocompatibility and so it is appropriate to be the first specialist module in the Histocompatibility and Immunogenetics variation to the Clinical Immunology curriculum.

Page 73 section 6.6 Year 3 Specialist Practice for Histocompatibility and Immunogenetics

The new module HI-5 entitled ‘Haematological Malignancy and Transplantation’ has been introduced as a replacement for the previous module HT-2 entitled ‘Clinical Haematology’ (shared with the Haematology and Transfusion syllabus). This better reflects the work of trainees in supporting the investigation and treatment of haematological malignancy.

Page 75 section 6.6 Year 3 Specialist Practice for Histocompatibility and Immunogenetics

The module entitled ‘Haemopoetic Stem Cell Transplantation’ has been renumbered HI-6 (previously CI-3B). Repositioning this specialist module after the common module CI-5/HI-5 is appropriate.

The table below gives a summary of the revised modules.

<table>
<thead>
<tr>
<th>Revised Modules for Clinical Immunology and Histocompatibility &amp; Immunogenetics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module</strong></td>
</tr>
<tr>
<td>CI-1</td>
</tr>
<tr>
<td>CI-2</td>
</tr>
<tr>
<td>CI-3</td>
</tr>
<tr>
<td>CI-4</td>
</tr>
<tr>
<td>CI-5</td>
</tr>
<tr>
<td>CI-6</td>
</tr>
</tbody>
</table>

For any queries regarding this change please email: nshcs@wm.hee.nhs.uk
Amendments – March 2013

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

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

The new version is called STP MSc Blood Sciences Version 4.0 for 2013-14

For any queries regarding this change please email: nshcs@wm.hee.nhs.uk

Amendments – March 2017

Revised Genetic Sciences Rotational Module

In 2016 the original STP in Genetic Sciences was reviewed, updated and extended to become the STP in Genomic Sciences. This programme includes 3 specialist outcomes in Genomics, Genomic Counselling and (for 2018) Molecular Pathology).

As part of this process the rotational module “CG-1 Genetics and Molecular Science” (shared by Genetic Sciences, Blood Sciences and Cellular Sciences) was revised and is now called "CG-1 Genomic Sciences: Genetics, Genomics and Molecular Science”. The revised module is now included within the STP in Blood Sciences. This amendment applies to trainees commencing STP in the academic year 2017/18.

Revised Histocompatibility and Immunogenetics work-based learning programme
In 2016 the British Society of Histocompatibility and Immunogenetics (BSHI) identified an urgent need to develop STP Histocompatibility and Immunogenetics (H&I) training to secure an adequate clinical scientific workforce in this area in order to meet the predicted growth in organ transplantation. The National School of Healthcare Science has worked with the BSHI to revise the work-based education and training of trainees in H & I within the STP in Blood Sciences. The MSc syllabus is unchanged. Changes to the work-based syllabus for H&I are summarised below.

Rotational Training

The rotational programme for trainees in H&I will now comprise:

<table>
<thead>
<tr>
<th>Rotation</th>
<th>Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(H&amp;I-7)</td>
<td>Immunity and the Principles and Practice of Histocompatibility and Immunogenetics</td>
</tr>
<tr>
<td></td>
<td>New module replacing Immunity and the Principles and Practice of Clinical Immunology</td>
</tr>
<tr>
<td>2 (HT-1)</td>
<td>Haematology and Transfusion Science</td>
</tr>
<tr>
<td>3 (CB-1)</td>
<td>Clinical Biochemistry – Investigation of Major Organ Function</td>
</tr>
<tr>
<td>4 (CG-1)</td>
<td>Genetics, Genomics and Molecular Science</td>
</tr>
<tr>
<td></td>
<td>New module replacing Genetics and Molecular Science</td>
</tr>
</tbody>
</table>

Specialist Training (work-based learning guide)

In specialist training the work-based syllabus has been modified to give more focus to the practical application of the knowledge and skills required by Clinical Scientists in Histocompatibility and Immunogenetics. Three Clinical Immunology plus two H&I modules have been replaced with one Clinical Immunology and 4 H&I modules. The modules complement each other in the following way:

The first module, Clinical Immunology in Histocompatibility and Immunogenetics, addresses the Clinical Immunology knowledge and skills relevant for H&I Clinical Scientists. The trainee will become familiar with methods and strategies to investigate clinical immunology and gain experience of the interpretation of patient results in a variety of clinical settings.

The second module, Histocompatibility, focuses on the understanding of the principles and practice of Histocompatibility leading to competence with the methods used in support of transplantation and blood transfusion.

In the third module, Solid Organ Transplantation, the focus is on the understanding of the clinical significance of Histocompatibility and Immunogenetics within the context of solid organ transplantation and blood transfusion and the trainee will become familiar with the interpretation and reporting of patient and donor results.

The fourth module, Immunogenetics focuses on the scientific principles of molecular techniques available for HLA typing and their applications for different clinical conditions.
During the final module, Haematopoietic Stem Cell Transplantation (HSCT) the trainee will gain experience of HLA typing in the matching of donors and suitable recipients in HSCT. They will perform relevant laboratory methods and gain experience of the interpretation and reporting of patient and donor results in a variety of clinical settings.

<table>
<thead>
<tr>
<th>Module 1 (H&amp;I-2)</th>
<th>Version 2012/13 to 2016/17</th>
<th>Module 1 (H&amp;I-8)</th>
<th>Version 2017/18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Histocompatibility</td>
<td></td>
<td>Clinical Immunology in Histocompatibility and Immunogenetics</td>
</tr>
<tr>
<td>Module 2 (H&amp;I-3)</td>
<td>Immunodeficiency and Immunotherapy</td>
<td>Module 2 (H&amp;I-9)</td>
<td>Histocompatibility</td>
</tr>
<tr>
<td>Module 3 (H&amp;I-4)</td>
<td>Hypersensitivity and Allergy</td>
<td>Module 3 (H&amp;I-10)</td>
<td>Solid organ transplantation</td>
</tr>
<tr>
<td>Module 4 (H&amp;I-5)</td>
<td>Haematological Malignancies and Transplantation</td>
<td>Module 4 (H&amp;I-11)</td>
<td>Immunogenetics</td>
</tr>
<tr>
<td>Module 5 (H&amp;I-6)</td>
<td>Haemopoietic Stem Cell Transplantation</td>
<td>Module 5 (H&amp;I-12)</td>
<td>Haemopoietic Stem Cell Transplantation</td>
</tr>
</tbody>
</table>

The new STP Blood Sciences version is called: STP MSc Blood Sciences version 1.0 for 2017

For any queries regarding these changes please email: nshcs@wm.hee.nhs.uk
Appendix 3: Good Scientific Practice

Good Scientific Practice
Section 1: The purpose of this document
There are three key components to the Healthcare Science workforce in the UK:

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

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

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

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

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

Good Scientific Practice uses as a benchmark the Health Professions Council (HPC) Standards of Proficiency and Standards of Conduct, Performance and Ethics, but expresses these within the context of the specialities within Healthcare Science, recognising that three groups of the workforce, Biomedical Scientists, Clinical Scientists and Hearing Aid Dispensers are regulated by the HPC. The aim is that the standards are accessible to the profession and understandable by the public.

Good Scientific Practice represents standards and values that apply throughout an individual’s career in healthcare science at any level of practice. The standards will be contextualised by the role within Healthcare Science that an individual undertakes. This means that the standards must be interpreted based on the role that an individual performs. For example, in supervised roles where individuals work within defined procedures, rather than autonomously, some standards will need to
be interpreted appropriately for the context of the specific role. There will, however, always be a requirement for an individual to work within the limits of their scope of practice and competence.

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

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

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

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

Section 2: The domains of Good Scientific Practice

Domain 1: Professional Practice

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

1.1 Professional Practice

1.1.1 Make the patient your first concern
1.1.2 Exercise your professional duty of care
1.1.3 Work within the agreed scope of practice for lawful, safe and effective healthcare science
1.1.4 Keep your professional, scientific, technical knowledge and skills up to date
1.1.5 Engage fully in evidence based practice
1.1.6 Draw on appropriate skills and knowledge in order to make professional judgements
1.1.7 Work within the limits of your personal competence
1.1.8 Act without delay on concerns raised by patients or carers or if you have good reason to believe that you or a colleague may be putting people at risk
1.1.9 Never discriminate unfairly against patients, carers or colleagues
1.1.10 Treat each patient as an individual, respect their dignity and confidentiality and uphold the rights, values and autonomy of every service user, including
their role in the diagnostic and therapeutic process and in maintaining
health and well-being.

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

1.2 Probit

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

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

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

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

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

1.3 Working with colleagues

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

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

1.3.3 Consult and take advice from colleagues where appropriate

1.3.4 Be readily accessible when you are on duty

1.3.5 Respect the skills and contributions of your colleagues

1.3.6 Participate in regular reviews of team performance.

1.4 Training and developing others

1.4.1 Contribute to the education and training of colleagues

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

1.4.3 Ensure that junior colleagues and students are properly supervised

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

1.4.5 Share information with colleagues to protect patient safety

1.4.6 Provide work-based development for colleagues to enhance/improve skills
and knowledge

Domain 2: Scientific Practice
As a part of the Healthcare Science workforce, you will keep your scientific and technical knowledge and skills up to date to effectively:

2.1 Scientific Practice

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

2.2 Technical Practice

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

2.3 Quality

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

Domain 3: Clinical Practice
As a part of the Healthcare Science workforce, you will keep your clinical skills up to date and undertake the clinical duties appropriate to your role in order to effectively:

### 3.1 Clinical Practice

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.1.16 Represent your discipline in multidisciplinary clinical meetings to discuss patient outcomes and the appropriateness of services provided

3.1.17 Ensure that regular and systematic clinical audit is undertaken and be responsible for modifying services based on audit findings.

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

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

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

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

Domain 4: Research, Development and Innovation

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

4.1 Research, Development and Innovation

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

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

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

3.1.4 Manage research and development within a governance framework

3.1.5 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

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

3.1.7 Interpret data in the prevailing clinical context

3.1.8 Perform experimental work, produce and present results

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

3.1.10 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>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical experiential learning</td>
<td>The cyclical process linking concrete experience with abstract conceptualisation through reflection and planning.</td>
</tr>
<tr>
<td>Clinical experiential learning outcomes</td>
<td>The activities that the trainee will undertake to enable and facilitate their learning in the workplace.</td>
</tr>
<tr>
<td>Competence</td>
<td>The ability of an individual to perform a role consistently to required standards combining knowledge, understanding, skills and behaviour.</td>
</tr>
<tr>
<td>Competence statements</td>
<td>Active and outcome-based statements that provide a further breakdown of the Learning Outcomes – reflecting what the trainee will be able to do in the workplace at the end of the programme. Each competence should be linked back to the numbered Learning Outcomes.</td>
</tr>
<tr>
<td>Component</td>
<td>An indication of the type of module within a learning guide, i.e. rotational, specialist or elective</td>
</tr>
<tr>
<td>Curricula</td>
<td>An outline of the expected educational outcomes across a subject area The learning that is expected to take place during the Scientist Training Programme described in terms of knowledge, skills and attitudes.</td>
</tr>
<tr>
<td>Division</td>
<td>A high-level description of an area of practice within healthcare science. There are three divisions: Life Sciences, Physical Sciences and Biomedical Engineering and Physiological Sciences.</td>
</tr>
<tr>
<td>Domains of learning</td>
<td>Cognitive (knowledge and intellectual skills), affective (feelings and attitudes), interpersonal (behaviour and relationships with others) and psychomotor (physical skills).</td>
</tr>
<tr>
<td>Feedback</td>
<td>Specific information about the comparison between a trainee’s observed performance and a standard, given with the intent to improve the trainee’s performance (van de Ridder JMM, Stokking KM, McGaghie WC and ten Cate OT. What is feedback in clinical education? <em>Medical Education</em> 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, 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>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------</td>
</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 a process in which a trainer (mentor) is responsible for overseeing the career and development of the trainee. The emphasis is therefore on the relationship (rather than the activity).</td>
</tr>
<tr>
<td><strong>Module aim</strong></td>
<td>The overall objective of a work-based learning module – defining the intended learning achievements of the trainee. The aim works together with the ‘Scope’ statement to define the overall objectives and scope of the module.</td>
</tr>
<tr>
<td><strong>Module scope</strong></td>
<td>A statement within work-based learning modules that defines the range/limits of the learning undertaken by the trainee in a module – patients/investigations/equipment/modalities, etc.).</td>
</tr>
<tr>
<td><strong>National Occupational Standards</strong></td>
<td>Nationally recognised standards of expected workplace performance and level of competence for a role. The standards are outcome based, defining what the role holder should 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</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------</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>
</tr>
</tbody>
</table>