Modernising Scientific Careers
Scientist Training Programme
Work-based Learning Guide

Clinical Bioinformatics 2017/18

Developing people for health and healthcare

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SECTION 1: GENERAL INTRODUCTION
READERSHIP

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

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

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

1.1 Scientist Training Programme (STP) Overview

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

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

3. The 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 HCS specialisms. With advances in scientific technology, changes to the delivery of healthcare scientific services and the development of MSC, the boundaries between these divisions have been shifting. MSC recognises this important change and to date has identified nine themes within HCS for the STP, which enables training across a total of 24 healthcare science specialisms, with curricula for additional specialisms still under development.

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

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

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

7. The MSc Clinical Science Learning Outcomes and Indicative Content, and the associated work based learning outcomes can be found by following the link [www.networks.nhs.uk/nhs-networks/msc-framework-curricula](http://www.networks.nhs.uk/nhs-networks/msc-framework-curricula). Further details of the MSc in Clinical Science can be found in the student handbook from the university with which each trainee is registered.
8. This introduction to work based learning provides an overview of the work based training programme and the guidance provided by the NSHCS for users of the online learning and assessment tool (OLAT) and e-learning portfolio. All trainees and trainers will have access to the OLAT throughout their training.

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

10. The work based training programme has four components, each underpinned by the professional practice curriculum:
   • induction
   • rotational training
   • elective training
   • specialist training.

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

12. Details of the work based assessment programme can be found in Section 3 of this guide and also by logging on to the OLAT. Details of the assessment programme for the MSc in Clinical Science will usually be published in the student handbook provided by each university.

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

- **Single Specialism Work Based Programme** to include a 4- to 6-week period of Elective Training.
- **Work Based Themed Rotational Programme**
  - 4x12 weeks
  - Specialism One
  - Specialism Two
  - Specialism Three
  - Specialism Four
- **Induction**
- **Year 1**
  - Theme
- **Year 2**
  - Specialist including Research Project
- **Year 3**
  - Specialist including Research Project
- **P/T MSc Clinical Science**
  - Blended learning (incl. problem based learning)
  - Generic Education and Training
  - Themed Education and Training
  - Specialist Education and Training
1.2 Outcomes of the Work Based STP

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

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

- a systematic understanding of clinical and scientific knowledge, and a critical awareness of current problems, future developments, research and innovation in health and HCS practice, much of which is at, or informed by, the forefront of their professional practice in a healthcare environment;
- clinical and scientific practice that applies knowledge, skills and experience in a healthcare setting, places the patient and the public at the centre of care, prioritising patient safety and dignity, and reflecting NHS/health service values and the NHS Constitution;
- clinical, scientific and professional practice that meets the professional standards defined by GSP and the regulator (HCPC);
- personal qualities that encompass self-management, self-awareness, acting with integrity and the ability to take responsibility for self-directed learning, reflection and action planning;
- the ability to analyse and solve problems, define and choose investigative and scientific and/or clinical options, and make key judgements about complex facts in a range of situations;
- the ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences, including patients and the public;
- the ability to be independent, self-directed learners demonstrating originality in tackling and solving problems, and acting autonomously in planning and implementing tasks at a professional level;
- a comprehensive understanding of the strengths, weaknesses and opportunities for further development of healthcare and HCS as applicable to their own clinical practice, research, innovation and service development, which either directly or indirectly leads to improvements in clinical outcomes and scientific practice;
- conceptual understanding and advanced scholarship in their specialism that enables the graduate to critically evaluate current research and innovation methodologies and develop critiques of them, and, where appropriate, propose new research questions and hypotheses;
- scientific and clinical leadership based on the continual advancement of their knowledge, skills and understanding through the independent learning required for continuing professional development.
14. Once registered as a clinical scientist, a range of career development options will be available, including competitive entry into Higher Specialist Scientist Training (HSST). Alternatively, others may choose to undertake further career development in post through a structured programme of continuing professional development (CPD), provided by Accredited Expert Scientific Practice, or pursue a clinical academic career. Clinical Scientists who successfully complete HSST, or who can demonstrate equivalence to its outcomes, will be eligible to compete for available Consultant Clinical Scientist posts.
1.3 Key Components of Work Based Training in STP

The trainee

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

16. At the core of successful work based training is appropriate educational supervision, facilitation and feedback. Each trainee will be allocated to a clinical training supervisor or training officer\(^1\) from within the employing host department. Trainees should ensure that a planned schedule of meetings with their training officer is agreed early in training, commencing with a meeting during the first week. Conversations between trainees and trainers are confidential, unless patient safety is at risk. When the trainee is following a rotational module a trainer from the host department will act as their main contact while they are away from their host department.

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

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

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

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

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

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

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

Organisation of the training programme

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

23. Induction

   At the start of the STP training programme and of each new placement, trainees should be provided with an induction programme explaining trust and departmental arrangements. Initial work based induction in the host department should include an overview of the:
   - hospital/healthcare setting and local policies, including health and safety, confidentiality, data protection, etc., relevant to the placement;
   - range of services provided by the department;
   - range of people who use the services provided by the department;
function, operation, and routine and corrective maintenance requirements of equipment appropriate to the section(s) of the department in which the trainee will be working.

Moreover, the host department should ensure that the trainee has access to:
- host trust information technology (IT) systems, including the library and knowledge service as necessary;
- Online Learning and Assessment Tool (OLAT).

Induction should include an early discussion (within the first week) between the trainee and their training officer so that the curriculum, assessment and placement arrangements can be discussed. In addition, trainers should provide trainees with copies of:
- Good Scientific Practice;
- the STP work based Learning Guide;
- the OLAT learning guide;
- links to the NSHCS (see Section 3 for details of the role of the NSHCS in relation to STP training).

24. Rotational training

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

The host department is responsible for setting the timetable for each of the four rotations, which will depend on local availability and may require some time to be spent outwith your locality to ensure that the learning outcomes in totality can be achieved. In agreeing the rotational training, the host department will need to consider the periods of time the trainee will be required to attend the university or undertake academic activities for the MSc within the workplace.

The host department must be familiar with the content, delivery and assessment programme of the MSc in Clinical Science that the trainee is undertaking at university, and ensure that the departments where the trainee is placed for rotational placements are also familiar with the expected outcomes of each period of training and are trained in the assessment methods. The training officer in the host department should maintain contact with the trainee and should liaise with the person taking overall responsibility for the trainee while they are undertaking the rotation. Supervision meetings between the training officer and the trainee should continue while they are on their rotational placements.

25. Elective training

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

26. Specialist training

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

27. Supervision

STP clinical and educational supervision should promote learning, reflective practice and support the trainee to produce action plans to address identified learning needs. It will need to ensure that the trainee learns specific skills and competencies, helping them to develop self-sufficiency and self-awareness in the ongoing acquisition of skills and knowledge. At every stage, patient safety must be paramount. Supervision will require the provision of pastoral care for some trainees. Supervision may, at times during the programme, be provided by other healthcare professionals outside healthcare science who will be appropriately trained, e.g. medical colleagues.

The first supervision meeting should be set up during the first week of the training programme. At this meeting the training officer should ensure that the trainee is undertaking an induction programme that includes the hospital and department. It is recommended that following areas should be explored and agreement reached at the first meeting with respect to the:

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

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

- national recruitment into STP, enabling a transparent and robust selection of the very best science graduates;
- providing national oversight of STP trainees throughout their training by managing and monitoring their progress through the OLAT, supporting trainees in difficulty, and 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 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.

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

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

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

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

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

Trainee assessment

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

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

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

31. The structure of the work based assessment programme

There are distinct elements of the work-based assessment programme for all trainees:
- assessment tools, see Table 1 overleaf;
- competency log;
- Online Learning and Assessment Tool (OLAT);
- exit assessment – Objective Structured Final Assessment (OSFA).

Assessment tools

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

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

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

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

34. Online Learning and Assessment (OLAT)

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

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

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

35. Objective Structured Final Assessment (OSFA)

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

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

Quality assurance of work based training

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

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

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

39. The NSHCS works in partnership with the professional bodies through its Themed Boards and the SHAs/LETBs to deliver a robust Quality Assessment Management (QAM) programme for the work based education and training programme. This QAM programme is UK-wide and independent from the direct delivery of education and training. The purposes of the QAM programme are to:
   - ensure all STP training environments are accredited to deliver work based training;
   - ensure that all training settings are working to the agreed standards;
   - create an open and transparent culture where issues and concerns can be raised, investigated and resolved;
   - ensure that trainees receive a high-quality educational experience wherever their training takes place;
   - identify and share examples of good practice;
   - provide evidence of the quality of work based education and training environments to those who regulate and register the profession;
   - provide evidence of the high standard of work based education and training, and assurance that these standards are robustly managed.

40. Details of the quality management approach is available from the NSHCS (Ref NSHCS Policy 03); in summary, the quality framework includes the following.
   - Receipt, analysis, review and response with respect to:
     - annual self-assessment progress reports from each work base;
     - trainee feedback questionnaires;
     - assessment progress reports;
     - ad hoc reporting of exceptions or changes to programmes;
     - individual work based education and training timetables for each trainee.
   - A mechanism for receiving and reviewing reports with respect to the STP programme from trainees, trainers, patients, or other stakeholders.
   - Visit programme, including:
     - a five-year rolling visit programme to each work base;
     - ad hoc visits to departments as required.

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

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

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

Further information can be found in Appendix 3.
SECTION 2: PROGRAMME OVERVIEW
STP WORK BASED TRAINING PROGRAMME IN CLINICAL BIOINFORMATICS

This STP has been designed to meet the education and training needs of both the NHS and UK Public Health Bodies. The diagram below provides an overview of the programme each trainee in Clinical Bioinformatics 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**

PROFESSIONAL PRACTICE

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

INDUCTION COMPONENT

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

Trainees on the Genomics route must then successfully complete the rotations shown below.

<table>
<thead>
<tr>
<th>Rotation 1 (CBI-1)</th>
<th>Introduction to Clinical Bioinformatics and Genetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (CBI-2)</td>
<td>Computing for Clinical Scientists</td>
</tr>
<tr>
<td>Rotation 3 (CBI-3)</td>
<td>Information and communications technology in the Clinical Environment</td>
</tr>
<tr>
<td>Rotation 4 (CBI-4)</td>
<td>Introduction to Health Informatics Science</td>
</tr>
</tbody>
</table>

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

**Order:** The order of all rotations can be agreed by the host department/training officer.

ELECTIVE COMPONENT

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

SPECIALIST COMPONENT: GENOMICS

<table>
<thead>
<tr>
<th>Module 1 (CBI-5)</th>
<th>Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (CBI-6)</td>
<td>Advanced Clinical Bioinformatics</td>
</tr>
<tr>
<td>Module 3 (CBI-7)</td>
<td>Applied Next Generation Sequencing</td>
</tr>
<tr>
<td>Module 4 (CBI-8)</td>
<td>Information Technology for Advanced Bioinformatics Applications</td>
</tr>
<tr>
<td>Module 5 (CBI-9)</td>
<td>Whole Systems Molecular Medicine</td>
</tr>
</tbody>
</table>

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

Within this learning guide examples of commercially available software are provided to illustrate the learning outcome/competence. Please note these examples are not exhaustive and other appropriate software can be used, and any commercially available software included does not imply that this is recommended for use by the authors.
ROTATIONAL COMPONENT: CLINICAL BIOINFORMATICS FOR PHYSICAL SCIENCES

Trainees following the Physical Sciences programme must then successfully complete the rotations shown below.

<table>
<thead>
<tr>
<th>Rotation 1 (CBI-1)</th>
<th>Introduction to Clinical Bioinformatics and Genetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (CBI-2)</td>
<td>Computing for Clinical Scientists</td>
</tr>
<tr>
<td>Rotation 3 (CBI-3)</td>
<td>Information and communications technology in the Clinical Environment</td>
</tr>
<tr>
<td>Rotation 4 (CBI-4)</td>
<td>Introduction to Health Informatics Science</td>
</tr>
</tbody>
</table>

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

**Order:** The order of all rotations can be agreed by the host department/training officer.

ELECTIVE COMPONENT

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

SPECIALIST COMPONENT: PHYSICAL SCIENCES

<table>
<thead>
<tr>
<th>Module 1 (DD-1)</th>
<th>The Project Life Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (DD-2)</td>
<td>Advanced Information and communications technology Skills</td>
</tr>
<tr>
<td>Module 3 (DD-3)</td>
<td>Database Management, Data Mining and Modelling</td>
</tr>
</tbody>
</table>

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

Trainees on the Health Informatics Science route must then successfully complete the rotations shown below.

<table>
<thead>
<tr>
<th>Rotation 1 (CBI-1)</th>
<th>Introduction to Clinical Bioinformatics and Genetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation 2 (CBI-2)</td>
<td>Computing for Clinical Scientists</td>
</tr>
<tr>
<td>Rotation 3 (CBI-3)</td>
<td>Information and communications technology in the Clinical Environment</td>
</tr>
<tr>
<td>Rotation 4 (CBI-4)</td>
<td>Introduction to Health Informatics Science</td>
</tr>
</tbody>
</table>

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

**Order:** The order of all rotations can be agreed by the host department/training officer.

**ELECTIVE COMPONENT**

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

**SPECIALIST COMPONENT: HEALTH INFORMATICS**

<table>
<thead>
<tr>
<th>Module 1 (HI-1)</th>
<th>Policy, Strategy and Operational Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (HI-2)</td>
<td>Co-Production of Health</td>
</tr>
<tr>
<td>Module 3 (HI-3)</td>
<td>Systems Development and Design</td>
</tr>
<tr>
<td>Module 4 (HI-4)</td>
<td>Information and Knowledge Management</td>
</tr>
</tbody>
</table>

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

*The following sections of the learning guide contain the learning frameworks for the rotational, elective, specialist and professional practice modules.*
SECTION 3: ROTATIONAL LEARNING FRAMEWORKS
STP Learning Framework

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

### Rotational Module

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Cross-Divisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Genomics</td>
</tr>
</tbody>
</table>
**MODULE TITLE** | Introduction to Clinical Bioinformatics and Genetics (CBI-1) | COMPONENT | Rotation
--- | --- | --- | ---
**AIM** | This module will provide the trainee with an introduction to clinical bioinformatics and genetics. They will understand the aims and operation of a genetics laboratory service. They will understand the role of bioinformatics and the bioinformatician in supporting the laboratory service, and the effect of data and its analysis on patient care. |  |  
**SCOPE** | On completion of this module the trainee will be able to apply standard bioinformatics tools and approaches to the analysis of genes and proteins, and assess the effect of genetic variation in the context of the diagnosis, management and care of patients and families with genetic conditions. |  |  

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Perform analysis on DNA data and protein sequence data to infer function.
2. Perform sequence alignment tasks followed by clustering and phylogeny.
3. Select and apply appropriate bioinformatic tools and resources from a core subset to typical diagnostic laboratory cases, contextualised to the scope and practice of a clinical genetics laboratory.
4. Compare major bioinformatics resources or pathogen typing and identification for clinical diagnostics and how their results can be summarised and integrated with other lines of evidence to produce clinically valid reports.
5. Interpret evidence from bioinformatic tools and resources and integrate this into the sum of genetic information for the interpretation and reporting of test results from patients.
6. Perform the recording of building or version numbers of resources used on a given date, including those of linked data sources, and understand the clinical relevance of this data.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe a clinical consultation(s) where patients with genetics disorders meet with health professionals to discuss their diagnosis and care, and reflect on the positive aspects of each consultation.
- With permission, identify a patient or family with a genetic disorder and discuss the impact of that genetic disorder on the quality of life of the patient and/or family with an appropriate clinical professional, and reflect on how this experience will influence your future practice.
- Attend multidisciplinary meetings at which the results of genetic investigations are discussed and reflect on the process, the weighting placed on different types of data, and the effect on patients’ results and care pathway.
- Gain experience of each of the following and personally reflect on the importance, application and effect on genetic services and patient care:
  - the scope and function of the genetics laboratory
  - the requirements and implementation of bioinformatic analysis strategies
  - investigation of genetic variants using in-silico techniques
  - annotation of DNA and protein sequences
  - use of standard protocols in analysis of genetic results
  - recording of results and preparation of reports for clinical use.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Take a protein sequence and use standard bioinformatic tools to locate within a genome, annotate and infer function.</td>
<td>• Theoretical basis of function prediction in bioinformatics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for protein function prediction based on sequence similarity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for protein function prediction based on conserved motifs and patterns.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The use of gene ontology to annotate function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The use of literature resources to support function prediction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The processes of combining predictive tools to provide evidenced protein function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Best practice guidelines and quality assurance (QA; both internal and external).</td>
</tr>
<tr>
<td></td>
<td>Take a DNA sequence and use standard bioinformatic tools to locate within a genome, annotate and infer function, including gene prediction, transcription factor (TF) analysis, splice-site boundaries, potential for copy number variants (CNVs).</td>
<td>• The genome sequence resources available.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The annotations provided by genome resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The different types of DNA sequence in databases – complete genome, cDNA, expressed sequenced tags (ESTs), function non-coding sequences.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for DNA sequence alignment, including those for matching large genomic sequences.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Resources for non-coding functional genomic regions (databases of transcription factor binding sites, CNVs, etc.).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Resources for alternatively spliced genes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for exon prediction – sequence based.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for exon prediction – signal based.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Tools for transcription factor (TF) prediction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The use of literature resources to support function prediction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The processes of combining predictive tools to provide evidenced protein function.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Best practice guidelines and QA (both internal and external).</td>
</tr>
<tr>
<td>3</td>
<td>Use three clinical cases to</td>
<td>• Application of bioinformatics tools within a clinical genetics service.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
</tbody>
</table>
|                      | demonstrate the application of bioinformatic tools to common genetic scenarios. | • Typical care pathways for patients with a genetic disorder.  
• Tools for single-nucleotide polymorphism (SNP) prediction.  
• The genome sequence resources available.  
• Potentials for errors in SNP prediction methods.  
• Validating SNP predictions. |
| 2, 3                 | Identify variation within genetic sequence data captured from various sources. | |
| 2                   | Reconstruct and interpret the relationship between individual sequences using phylogenetic analysis. | • Alignment and clustering algorithms.  
• Phylogenetic tree building.  
• How to interpret phylogenetic analysis. |
| 3, 4, 5             | Analyse variants using literature and bioinformatic tools or resources to predict consequence and determine significance within patient care. | • The aims and operation of a genetics laboratory service.  
• The principal referral reasons that would indicate testing for common genetic conditions.  
• Modes of inheritance.  
• The clinical and scientific basis for the repertoire of genomic testing available to investigate the common range of clinical referrals.  
• The reasons for pathogen samples to be sent to hospital or reference microbiology laboratories for sequencing.  
• The role of bioinformatics and the bioinformatician in supporting the laboratory service in the context of clinical diagnosis, the effect of data and its analysis on patient care.  
• How to search the literature for information on the consequences of variation in genetic loci of the human genome or the pathogens infecting a host.  
• Correct interpretation of the genetics literature on variation.  
• Location of resources relating to the consequences of variation including antimicrobial resistance databases.  
• How to search variation databases for information on variants. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Correct application of interpretation tools.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Correct use of data from databases or interpretation tools.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Collation of data from different sources on variation consequences to infer potential effects on patient care.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The influence of user interfaces on results.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The implications of the genomics investigations (including ethical, legal and social implications) on the patient and patient care.</td>
</tr>
<tr>
<td>1, 2, 3, 4, 5, 6</td>
<td>Follow standard protocols or agreed procedures for sequence annotation and analysis.</td>
<td>• How to locate and follow local protocols.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to identify applicable standard protocols for analysis made available through professional genetics organisations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to identify standards within the hospital and public health settings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ethical issues associated with patient consent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clinical and information technology (IT) governance rules for analysis of patient data.</td>
</tr>
<tr>
<td>6</td>
<td>Make accurate records of all work carried out.</td>
<td>• The reasons for keeping accurate records.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Minimum data sets for describing the analysis process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identify local and national guidelines for record keeping.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Applicable NHS or public health function requirements for record keeping.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provision of evidence that quality standard operating procedures (SOPs) have been followed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The location of relevant metadata within bioinformatic resources.</td>
</tr>
<tr>
<td>4, 5, 6</td>
<td>Communicate results in a way that is useful to the clinical team, highlighting their findings.</td>
<td>• The information needs of clinical genetics and other healthcare teams.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local policies for clinical reporting and differences between centres.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Relevance and limitations of data from specific sources to the case(s) of interest.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The operation of laboratory information systems for recording results and generating reports.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The process for generation and validation of clinical reports.</td>
</tr>
</tbody>
</table>
STP Learning Framework

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

Rotational Module

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</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Computing for Clinical Scientists</td>
</tr>
</tbody>
</table>
AIM
This module will ensure that the trainee can configure novel information and communications technology (ICT) hardware and software solutions safely within the clinical environment, and understands the impact of this work on the patient, including patient safety and the healthcare services supported by a range of computer systems.

SCOPE
In this module trainees will be introduced to the fundamental aspects of computer science needed to support data management and the principles of modern software engineering processes such that they can better engage with and support software development within the NHS. In this module, the trainee will usually undertake a small project to plan, assemble, describe, design and test a software solution to solve a clinical problem, using appropriate software language and governance. Trainees will also be expected to develop and build their professional practice and contextualise their learning to the impact of their work on the patient and patient care.

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

1. Plan a process and assemble the requirements for a clinical information system.
2. Express system requirements in Unified Modelling Language (UML).
3. Design a relational database system for a clinical information system ensuring an appropriate level of data normalisation.
4. Build an information system allowing web access to a Structured Query Language (SQL) database.
5. Construct a range of appropriate SQL commands.
6. Complete the project documentation ensuring compliance with security, governance and ethics issues with web-accessible database systems.
CLINICAL EXPERIENTIAL LEARNING
The clinical experiential learning for this module is:

- Observe the work of the department and discuss the role of ICT hardware, software and network components within the context of the work placement with your training officer.
- Observe the administration of a local area network (user specification, initial set-up, shared resources and security issues) and reflect on the impact and risks of local area networks within the department and wider NHS with your training officer.
- Observe and assist in programming, using an appropriate language (e.g. MS VB, MS VBA-Excel, Matlab, Java) to analyse and report clinical measurement or other results.
- Observe and assist in applying standards (e.g. IEC601) and techniques that are required when ICT software and hardware is utilised within a clinical setting and reflect on your learning and how it will improve your future practice as a Clinical Scientist.

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

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

PROFESSIONAL PRACTICE
Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Write a project plan using project management methodology. | • The requirements of a formal project management methodology.  
• Formal project management methodologies (e.g. Prince II, SSADM).  
• Software life cycle, e.g. Waterfall, Iterative, TickIT.  
• The use of a computer as a clinical device.  
• EU Medical Devices Directive (MDD).  
• Food and Drug Administration (FDA)/Medicine and Healthcare products Regulatory Agency (MHRA). |
| 1                     | Interview users and translate user requirements into a functional specification. | • Communication skills, including active listening, use of appropriate shared language.  
• How the output from the project will be used in the clinical environment, including patient care.  
• Formal processes for gathering requirements.  
• Functional and non-functional requirements.  
• UML and systems modelling. |
| 1                     | Select appropriate hardware and software. | • Operating systems.  
• Hardware platform.  
• Development language(s).  
• Different software development models: Waterfall vs Agile.  
• Managing code effectively – version control systems. |
| 2                     | Express system requirements in UML. | • Elements of UML: use cases.  
• Capturing requirements – the idea of use cases.  
• Basic introduction to SQL.  
• Basic introduction to theory of normalisation.  
• Database design in an SQL-92 environment.  
• Application programming interfaces (APIs) for communication with databases. |
<p>| 3                     | Extract a data structure into third normal form using a formalised | • Third normal form. |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>process.</td>
<td></td>
<td>• Relational database concepts (primary key, joins, etc.).</td>
</tr>
<tr>
<td>3</td>
<td>Ensure the design is fit for purpose.</td>
<td>• Testing methodologies.</td>
</tr>
<tr>
<td>4</td>
<td>Link an SQL engine to a web server, ensuring compliance with the security</td>
<td>• Bandwidth.</td>
</tr>
<tr>
<td></td>
<td>requirements for a multi-user system.</td>
<td>• Replication.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Common database security issues.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Governance and ethics associated with information systems in the NHS.</td>
</tr>
<tr>
<td>5</td>
<td>Create an SQL statement using either the SQL query builder or the SQL query</td>
<td>• SQL commands for creating and manipulating a database.</td>
</tr>
<tr>
<td></td>
<td>wizard.</td>
<td>• Use and maintenance of indices.</td>
</tr>
<tr>
<td>6</td>
<td>Complete the formal documentation at the end of the project.</td>
<td>• Security, governance and ethics issues with web-accessible database systems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Data protection legislation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Caldicott guidelines.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Freedom of Information Act.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The role of ethics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Additional security requirements as a system moves from single-user to multi-user.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Encryption, e.g. Pretty Good Privacy (PGP).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Anti-virus measures.</td>
</tr>
</tbody>
</table>
STP Learning Framework

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

Rotational Module

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<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Cross-Specialism</td>
</tr>
</tbody>
</table>
### AIM

This module will provide the trainee with an overview of how information and communications technology (ICT) is used in the clinical environment and will enable the trainee to apply analytical and judgement skills to novel or complex clinical measurements, implement new clinical measurement solutions, and understand and configure novel ICT hardware and software solutions safely within the clinical environment with due respect for patients and patient safety.

### SCOPE

On completion of this module the trainee will gain experience of the principles underpinning a range of basic clinical measurement and be able to acquire clinical measurement data. They will apply their knowledge with respect to the role of ICT hardware, software and network components within the context of Medical Physics and Clinical Engineering. Trainees will be expected to develop and build their professional practice.

### LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Observe and assist during a range of clinical measurement procedures effectively and safely with due regard to the patient, health and safety, data security and governance in ICT within the context of Medical Physics and Clinical Engineering.
2. Develop a prototype image processing application.
3. Manipulate data using a spreadsheet or database environment and an appropriate programming language.
4. Use configuration control in relation to PC software installations and local area networks, including the installation of systems and applications.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe the work of the department and discuss the role of ICT hardware, software and network components within the context of Medical Physics and Clinical Engineering with your training officer, identifying areas of good practice and potential improvements.
- Observe and participate in a range of clinical measurements (which may cover electrophysiology, pressure and/or flow) and reflect on how each contributes to the care pathway of the patient, attending multidisciplinary team meetings where practicable.
- Observe the administration of a local area network (user specification, initial set-up, shared resources and security issues) and reflect on the impact and risks of local area networks within the department and wider NHS with your training officer.
- Observe the transfer, archiving and display of medical images within radiology and other relevant areas within secondary care, and critically analyse the process, identifying strengths and potential for improvement against local guidelines.
- Follow the ICT workflow from patient referral and appointment, through modality work list, data acquisition, archiving and reporting, and discuss with your supervisor the impact of ICT workflow on the throughput of the department and the patient.
- Follow the ICT workflow from subject identification and consent through to Clinical Report Form completion and collection of other data sources such as images or genomic sequences. Discuss with your supervisor the impact of ICT workflow on the recruitment process.
- Observe a clinical trial(s) at different stages, focusing on how ICT is used to support clinical trials, and assist in data processing for a clinical trial, focusing on how data quality is ensured and the methods by which data are transferred and processed, and discuss the limits to which routinely collected clinical data can be used for research and how such uses can be provisioned and controlled with your training officer.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assist staff undertaking clinical measurement procedures, including set-up, calibration, test performance, analysis, reporting and filing/storage of results.</td>
<td>• Control of infection procedures, including hand washing. • Principles, guidance and law with respect to informed consent. • Importance of explaining your job role and the procedure to the patient and confirming patient identity. • Standard operating procedures (SOPs). • How to communicate with patients in a way that respects their dignity, rights, privacy and confidentiality. • The processes for de-identifying medical images or other file-based data. • The types of processes employed for de-identifying structured clinical data, such as k-anonymity. • Mechanisms for secured data capture and transfer. • Data protection laws as they apply internationally, both within the EU and outside. • Data retention policies, in particular deletion, related to research data and how these impact on the ICT system design process.</td>
</tr>
<tr>
<td>1, 2</td>
<td>Analyse data and report on the use of specific measurements (particularly in terms of accuracy, reproducibility, bias, specificity and sensitivity) in the context of bioinformatics.</td>
<td>• Sources of appropriate literature relating to the technical, scientific and clinical basis of clinical measurements. • Common artefacts in equipment calibration and performance. • Statistical tests applied to clinical measuring data to measure accuracy, precision, resolution and bias. • Range of statistical tests and the appropriate choice for each situation. • Use of commonly available databases, spreadsheets and statistics packages. • Concept of Patient Identifiable Data and the process of de-identification for both teaching and research purposes.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
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</tr>
<tr>
<td>2</td>
<td>Identify the need for a software application to support image processing and develop the prototype, document and comment appropriately.</td>
<td>• Governance and ethical issues surrounding such secondary use of data.</td>
</tr>
<tr>
<td>2</td>
<td>Test and, where possible, deploy the image processing software.</td>
<td>• Underlying physics of the task.</td>
</tr>
<tr>
<td>3</td>
<td>Analyse, manipulate, summarise and present complex data using a spreadsheet or database for clinical and scientific applications.</td>
<td>• Appropriate use of software tools.</td>
</tr>
<tr>
<td>3</td>
<td>Present complex data using spreadsheets or databases for clinical and scientific applications.</td>
<td>• EU Medical Device Directive.</td>
</tr>
<tr>
<td>3</td>
<td>Explain complex data to a non-expert.</td>
<td>• The use of the software application in patient care or service delivery.</td>
</tr>
<tr>
<td>3</td>
<td>Participate in the implementation of ICT components in a controlled fashion, taking into account the impact on existing facilities and clinical service.</td>
<td>• Sources of appropriate literature relating to the technical, scientific and clinical basis of clinical measurements.</td>
</tr>
<tr>
<td>4</td>
<td>Participate in the maintenance of protective measures for ICT systems, including disaster measures, anti-virus protection,</td>
<td>• Statistical tests applied to clinical measuring data to measure accuracy, precision, resolution and bias.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Range of statistical tests and the appropriate choice for each situation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use of commonly available databases, spreadsheets and statistics packages.</td>
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<tr>
<td></td>
<td></td>
<td>• Oral communication skills, including explaining, describing, listening, language, non-verbal behaviour, summarising, types and use of questions.</td>
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<tr>
<td></td>
<td></td>
<td>• Use of computing in the context of Medical Physics and Clinical Engineering.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Configuration control and administration of local area networks.</td>
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<tr>
<td></td>
<td></td>
<td>• The security and data governance processes in ICT within the context of Medical Physics and Clinical Engineering.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Security, protective measures and routine housekeeping tasks for server-based applications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• IT security and data integrity.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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</tbody>
</table>
|                      | maintenance, updating, firewalls and virtual servers/networks. | • Governance issues relating to patient data.  
• Operation of major ICT hardware, software and networking components.  
• Concept of a system in the context of electrical safety.  
• Software development methodology, e.g. SSADM.  
• Appropriate programming languages, e.g. C++, Microsoft Dot.Net, Matlab, Java, Python and/or PHP.  
• Web development tools.  
• System and applications software for void PCs. |
STP Learning Framework

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

Rotational Module

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Cross-Divisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Health Informatics Science</td>
</tr>
<tr>
<td>MODULE TITLE</td>
<td>Introduction to Health Informatics Science (CBI-4)</td>
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</tr>
<tr>
<td><strong>AIM</strong></td>
<td>This module will provide the trainee with the basic informatics knowledge and understanding of the skills and tools needed by all professionals in modern healthcare systems to provide safe, secure, high-quality, effective patient-centred services.</td>
</tr>
<tr>
<td><strong>SCOPE</strong></td>
<td>On completion of this module the trainee will be able to apply the learning and the work based training to direct patient care and improved patient safety.</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Successfully complete the national Information Governance training module (with a score of more than 80%).
2. Perform a clinical audit and produce an audit report.
3. Advise peers and colleagues on best practice in data and information security, patient confidentiality, record sharing, information sharing with patients/clients and records access by the patient.
5. Send, receive and store communications containing patient/clinical information safely and securely in accordance with policy, protocols, legislation and codes.
6. Perform a review of a local clinical IT system for patient safety and security compliance.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Take up a project (or part of the project) endorsed by the Chief Clinical Information Officer or other informatics lead in assisting in managing and developing local approaches to informatics strategic planning and implementation, and reflect on how the new and emerging technologies, the information and intelligence analysis, and the capacity, capability and composition of the workforce (including the specialist health informatics science professionals) will play an important role in enabling the healthcare provider to respond to a range of challenges, such as:
  (a) safety (avoidance of adverse incidents)
  (b) effectiveness (evidence-based treatment and care)
  (c) patient-centred approach and equity (reduces variation in care provision based on individuals' traits)
  (d) efficiency (reduction in delays in care and avoidance of waste (underuse/overuse) of resources (including money, people, equipment, supplies and energy).

- Observe other professionals inputting, retrieving and sharing information with patients and supporting patients to access clinical information and/or their own records and discuss your experience in relation to two of the areas identified below:
  (a) response to illness
  (b) patient and carer perspective
  (c) diversity of the patient experience
  (d) disability, including learning disabilities
  (e) potential health inequalities
  (f) self-care
  (g) impact of life-threatening and critical conditions
  (h) patient involvement in decisions regarding their healthcare.

- Review opportunities for the application of e-health* in the host organisation and reflect on the impact of this on your practice as a Clinical Scientist:
  (a) changing demographics, disease patterns and types of household
  (b) better informed and expert patients with higher expectations related to both outcomes and experience
  (c) the Wellness paradigm – with responsibility for wellbeing shifting into patients’ hands
  (d) reorienting of healthcare services (e.g. moving from secondary care to community care)
  (e) requirements for affordability and sustainability of services for all who need them
  (f) the implications of tele-health applications for patients and clinical staff, clinical practice and communications.
*The term e-health can encompass a range of services or systems that are at the edge of medicine/healthcare and information technology, including electronic patient records, tele-medicine, consumer health informatics, m-health and virtual healthcare teams, to name but a few.

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

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

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</table>
| 1                     | Apply information governance principles and best practice in the workplace and pass the national Information Governance training module. | • The legislation, regulatory guidance and NHS protocols regarding the security, confidentiality and appropriate sharing of patient identifiable information.  
• Role of the Caldicott Guardian.  
• The different arrangements and the associated responsibilities of clinical staff for security of all types of clinical information, especially electronically held, and for using such data for ‘secondary’ purposes. |
| 2                     | Design and carry out clinical audit with relevant supporting information. | • The purpose, principles and practice of clinical governance in health organisations, how patients can be involved and the implications of the emergence of the expert patient.  
• Different kinds of audit.  
• How to identify a topic area, gain the necessary approval and perform a clinical audit.  
• Stages in the clinical audit process.  
• Criteria for an appropriate area of study and associated standards.  
• Ethical considerations. |
| 2                     | Analyse and interpret the data from a clinical audit and prepare a written report, including an action plan. | • The sources of information needed for effective clinical governance and audit, including access to appropriate evidence-based information and patient record access.  
• The relationship and differences between data, information and intelligence, and how they can all be used to support clinical practice and service management.  
• Statistical analysis and interpretation.  
• Options appraisal.  
• Report writing. |
<p>| 2                     | Present the findings from a clinical audit to an audience of peers. | • How clinical audit contributes to clinical governance, improving overall clinical practice, personal clinical practice and performance, |</p>
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</table>
| 3                     | Create and use patient-related data, applying data and information security best practice in a clinical context, and advise and support peers and colleagues about data and information security best practice related to patient information. | and, if applicable, reaccreditation.  
- Summarising, evaluating, appraising and presenting information/evidence.  
- How routine direct online access to their records provides patients with evidence-based information to help them make decisions about care, including self-care.  
- Sources of information about patient and public views and expectations for healthcare and related services.  
- The importance of data transparency, on the assumption that all data is available to the patient.  
- The benefits and risks, for both patients and professionals, of patient record access and sharing; how to maximise the benefits, how the consultation is affected by patient record access and how the system is affected by record access.  
- Decision aids.  
- Transactional services for patients, e.g. appointment booking, requesting repeat prescriptions, the ability of patients to add to their record.  
- Principles of acceptable, effective communications and information exchange with patients and carers and how this can be achieved in clinical practice.  
- Implications of patient-held and patient-accessible clinical information for interprofessional clinical practice and multidisciplinary care.  
- How coding impacts on the production of information that patients are able to access.  
- Nature and importance of shared meaning for interprofessional communications. |
<p>| 3                     | Store, manage and share records and patient information appropriately, safely and securely with others, including patients/clients. |  |
| 3                     | Provide advice and guidance to patients/clients and citizens regarding access to and ownership of personal health information/records. |  |</p>
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<tr>
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<td>• Purpose, basic structures, use and storage of patient health records, including paper-based and electronic patient records, and patient-held records.</td>
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<td>• Differences and importance of both structured, coded records and free text.</td>
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<td>• Basis, application and limitations of the different clinical coding systems in use, including terminologies, classifications and related vocabularies.</td>
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<td>• Use of clinical terms in recording clinical information in the patient record, and how that can facilitate reporting and analysis.</td>
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<tr>
<td></td>
<td></td>
<td>• The importance of high-quality coded clinical data for the quality of clinical practice, the safety of patients and the communication of clinical information.</td>
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<td></td>
<td></td>
<td>• Data, information and knowledge – similarities and differences with regard to security and confidentiality.</td>
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<tr>
<td></td>
<td></td>
<td>• Security and confidentiality risks and issues associated with patient-based data and information in paper and electronic forms in primary and acute settings.</td>
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<tr>
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<td></td>
<td>• Sharing data and information across sectors, i.e. health, social care and public health – risks, issues and challenges.</td>
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<td></td>
<td>• Patient and the public perspectives on personal information security, confidentiality and record sharing, including consent.</td>
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<tr>
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<td></td>
<td>• Records access – overview of the strategies, politics and practice; rights, roles and responsibilities.</td>
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<td></td>
<td>• How routine online patient record access influences the behaviour and attitudes of patients and professionals.</td>
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<tr>
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<td>• Record-keeping standards.</td>
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<tr>
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<td></td>
<td>• The qualities of good data and information and secondary uses of</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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</tbody>
</table>
| 4                    | Map the information flow between different sectors of health and social care. | - Different communication methods and technologies and their appropriate application in support of clinical practice.  
- Principles of acceptable, effective communications and information exchange with patients and carers and colleagues across the publicly funded sector.  
- Level of access required to different parts of the personal health record.  
- Consent models, confidentiality and security to ensure appropriate individual and team access to patient records.  
- The implications of the integration of patient-identifiable clinical information within the NHS.  
- How coded data are important for supporting business workflows and administration, as well as measuring quality outcomes. |
| 4                    | Locate and access sources of clinical knowledge and decision support and write a short report to explain how these resources can be used to improve patient care. | - Derivation and uses of patient data for research and evidence-based practice.  
- The range, purposes, benefits and potential risks of aggregating clinical data.  
- Implications of computerised care pathways and clinical guidelines for patient care.  
- Nature of decision support tools and how they are used to support clinical activity.  
- Accessing the ‘knowledge base of health’ (scientific research, guidelines, protocols, etc.).  
- The importance of coded data for clinical research, epidemiology, public health and the conduct of national audit.  
- The nature and application of specific care pathways, e.g. National Institute for Health and Clinical Excellence (NICE) Pathways; |
<table>
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<tr>
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<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Liverpool Care Pathway, Cancer Care Pathway, Map of Medicine; and local/regional/condition-based knowledge bases.</td>
</tr>
</tbody>
</table>
| 5                    | Send, and receive and manage information from other professionals, in written or electronic formats according to security and confidentiality requirements. | • Patient consent.  
• Levels of access (by professionals).  
• Sharing protocols, risks and issues.  
• File storage and retrieval.  
• Social media – risks and issues. |
| 5                    | Critically review available evidence to identify common breaches of security and confidentiality and propose ways to reduce these errors. | |
| 6                    | Carry out an initial assessment of a local IT-based clinical system for compliance with safety and security best practice. | • How and why information technology is able to support clinical practice and new ways of working.  
• Examples of functionality of commonly used clinical systems and applications.  
• Advantages and disadvantages of patient-focused versus specialty-, procedure- or disease-focused systems.  
• Emerging information and communications technologies and their application in health.  
• Awareness of clinical systems errors/reliability (e.g. transfer of data between platforms, data entry errors).  
• Risks and issues associated with digital health information/records/systems and mitigating actions.  
• Critical appraisal skills. |
SECTION 4: PROFESSIONAL PRACTICE LEARNING FRAMEWORK
This section describes the Learning Framework for the Professional Practice Component of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence, and Applied Knowledge and Understanding. This module spans the Rotational and Specialist period of training. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

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

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

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

Professional Practice in the STP Training Programme

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

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

The Learning Framework that defines the learning outcomes, clinical experiential learning, competences, and knowledge and understanding are contained on the following pages.
**MODULE TITLE** | Professional Practice (PP1) | COMPONENT | GENERIC
---|---|---|---
**AIM** | Professional Practice is part of the generic curriculum (applicable to all trainees) on the Scientist Training Programme. The overall aim of the module is to ensure that each trainee has the underpinning knowledge and applies this and the accompanying skills and attitudes to work as a healthcare scientist in accordance with *Good Scientific Practice* (GSP). |  | 
**SCOPE** | *GSP* sets out the principles and values on which the practice of healthcare science is undertaken. It sets out for the profession and the public the standards of behaviour and practice that must be achieved and maintained in the delivery of work activities and the provision of care. This module encompasses the knowledge, skills, experience and attitudes across four of the five domains of *Good Scientific Practice*, namely Professional Practice, Scientific Practice, Clinical Practice, Research and Development, and Clinical Leadership, but all other modules within this programme will contribute to embedding professional practice at the centre of the work of each trainee. |  | 

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

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

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

**Research, Development and Innovation**
8. Apply knowledge, skills and experience of research, development and innovation appropriate to the role in order to identify effectively actions that will improve service provision.

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

**Clinical Leadership**

10. Demonstrate a range of leaderships skills required of an emerging leader within healthcare science.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

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

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

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.
<table>
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<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</thead>
<tbody>
<tr>
<td><strong>Professional Practice</strong></td>
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</tr>
</tbody>
</table>
| 1 | Treat each patient as an individual, respecting their dignity and confidentiality and upholding the rights, values and autonomy of every service user. | • NHS Constitution.  
• Patient-centred care and the patient carer perspective with respect to:  
  - response to illness  
  - patient and carer perspective  
  - health belief models  
  - diversity of the patient experience  
  - disability, including learning disabilities  
  - potential health inequalities  
  - self-care  
  - impact of life-threatening and critical conditions  
  - patient involvement in decisions regarding their healthcare.  
• Local guidelines for responding to unacceptable behaviour by patients, carers, relatives, peers and colleagues, including harassment, bullying and violent behaviour. |
| 1 | Discuss personal values, principles and assumptions, emotions and prejudices, and how these may influence personal judgement and behaviour, and identify how you will practise in accordance with Good Scientific Practice. | • Good Scientific Practice.  
• The importance of maintaining own health. |
| 2 | Communicate effectively with the public, services users and other healthcare professionals, adapting | • The principles of effective communication, including:  
  - written and electronic, verbal and non-verbal and feedback  
  - the way effective communication can assist in identifying problems accurately, increase patient satisfaction, enhance treatment adherence, and reduce |
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<tr>
<th>KEY LEARNING OUTCOMES</th>
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</table>
|                       | communication style and language to meet the needs of listeners.            | patient distress and anxiety  
|                       |                                                                             | the importance of some key ideas, for example signposting, listening, language, non-verbal behaviour, ideas, beliefs, concerns, expectations and summarising in communication  
|                       |                                                                             | the range of question types that can be used in a communication.  |
| 2                     | Give and receive feedback sensitively to or from a peer or colleague.       | The range of feedback models for giving and receiving feedback.  
|                       |                                                                             | The evidence base underpinning the importance of effective feedback/feedback models.  |
| 2                     | Obtain, analyse and act on feedback from a variety of sources and use it to consider personal impact and change behaviour. | How to analyse feedback and frameworks for action planning.  
|                       |                                                                             | Behavioural change models.  |
| 2                     | Present complex ideas in understandable terms in both oral and written formats. | The importance of public engagement in science and its role in health and society.  
|                       |                                                                             | The factors that enable scientists to communicate to specialist and non-specialist audiences.  
|                       |                                                                             | Barriers to effective communication.  |
| 2                     | Use effective negotiation skills, including influencing colleagues.         | Communication channels with/in your host department, patients and the public, your employing institution, your profession and professional body, and the wider healthcare science community.  |
| 2                     | Work constructively and effectively as a member of a multidisciplinary team. | The underpinning principles of effective teamwork and working within and across professional boundaries.  |
| 3                     | Comply with relevant guidance and laws, to include those relating to:       | Principles, guidance and law with respect to:  
|                       | your scope of practice                                                     | medical ethics  
|                       |                                                                             | confidentiality  
<p>|                       |                                                                             | information governance  |</p>
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<tbody>
<tr>
<td></td>
<td>• research ethics and governance</td>
<td>• informed consent</td>
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<td></td>
<td>• patient confidentiality</td>
<td>• equality and diversity</td>
</tr>
<tr>
<td></td>
<td>• data protection</td>
<td>• child protection</td>
</tr>
<tr>
<td></td>
<td>• equality and diversity</td>
<td>• elder abuse</td>
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<tr>
<td></td>
<td>• use of chaperones</td>
<td>• use of chaperones</td>
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<td></td>
<td>• informed consent</td>
<td>• probity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• fitness to practise</td>
</tr>
<tr>
<td>4</td>
<td>Contribute to the education and training of colleagues.</td>
<td>• the importance of maintaining your own health.</td>
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<tr>
<td>4</td>
<td>Take responsibility for your learning and demonstrate a commitment to</td>
<td>• The key principles and evidence base underpinning clinical education,</td>
</tr>
<tr>
<td></td>
<td>continuing professional development</td>
<td>encompassing curriculum design, planning, delivery and assessment.</td>
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<tr>
<td>4</td>
<td>Meet commitments and goals in your professional practice, using a range</td>
<td>• How continuous personal development can improve personal performance.</td>
</tr>
<tr>
<td></td>
<td>of organisational and planning tools.</td>
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<tr>
<td>4</td>
<td>Reflect on your practice and</td>
<td>• Core theories of learning, particularly adult learning and reflective practice, and</td>
</tr>
<tr>
<td></td>
<td>generate a reflective diary that demonstrates how you utilise the skills</td>
<td>demonstrate how these are relevant to your practice as a healthcare scientist.</td>
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<tr>
<td></td>
<td>required of an independent learner and your commitment to your</td>
<td>• Personal values, principles and assumptions, emotions and prejudices,</td>
</tr>
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<td></td>
<td>continuing professional development.</td>
<td>understanding how these may influence personal judgement and behaviour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The role of critical reflection and reflective practice and the methods of reflection</td>
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<td></td>
<td>that can be used to maintain or improve knowledge, skills and attitudes.</td>
</tr>
<tr>
<td>4</td>
<td>Take responsibility for keeping your professional</td>
<td>• How to horizon scan, identify and evaluate the potential role for new and innovative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>technologies and scientific advances.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
| and scientific knowledge and skills up to date. | 4 Develop an action plan based on your experiential learning and reflection on completion of the Scientist Training Programme. | • Action planning.  
• Models and frameworks for critical reflection. |
| Clinical Practice | 5 Use a range of information and communications technologies within the workplace for service delivery, research, audit and innovation, including data filing and archiving:  
• word processing  
• databases  
• statistics packages  
• PowerPoint  
• internet  
• email. | • The range and application of clinical information systems used in the work base.  
• The systems in use in the work base to file and archive information and the processes for retrieval.  
• The principles underpinning identification, storage and retrieval of scientific literature, for example end note/end note web.  
• The purpose of a range of NHS information systems, including the regulations in place to ensure data security and confidentiality. This may include hospital information system, linked information systems (e.g. laboratory information management system) and middleware linking equipment to information systems. |
| 6 Under supervision, demonstrate that you can obtain and present a patient history from a normal volunteer or consenting patient in order | • The importance of patient-centred care and how it ensures that the wishes, beliefs, concerns, expectations and needs of patients are respected.  
• Patient and carer perspective with respect to illness, disability, health inequalities and diversity of the patient experience.  
• Structured models for presenting a patient history.  
• Process of patient-centred interviewing and the features of a good consultation, |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>to better understand the clinical decision-making process in your clinical practice.</td>
<td>including initiating the session, gathering information, building the relationship, explaining and planning, and closing the session.</td>
<td>• Link between the patient history and examination and development of clinical investigation and management plans.</td>
</tr>
<tr>
<td>7</td>
<td>Apply current regulations with respect to patient safety and safe systems within the workplace. To include, as appropriate to scope of practice: - risk management - biological specimen handling - COSHH - RIDDOR - radioactivity - fire safety - electrical safety - moving and handling - display screen equipment - incident reporting - infection control.</td>
<td>• The importance of health and safety within the workplace, wider healthcare environment and NHS. • Principles, process and governance of risk management. • Factors influencing health, safety and security. • Current legislation, codes of practice, guidance notes and related documents. • Principles and practice of health and safety in the workplace. • The requirements of relevant local health and safety guidelines, manuals and other documents, including the underpinning legislation. • The cause of errors related to patient safety, including patient and/or sample identification.</td>
</tr>
<tr>
<td>7</td>
<td>Use clinical coding and medical terminology in accordance with stated guidance, as appropriate to scope of practice.</td>
<td>• The importance of the correct use of clinical coding and medical terminology in contributing to good healthcare science practice. • Information governance principles and process.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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</tbody>
</table>
| 7                     | Keep accurate records in accordance with current guidelines and the legal framework for data security. | • Best practice recommendations for record keeping and data security.  
  • The Data Protection Act and current key guidelines, and the legal framework for data security. |
| 7                     | Use, in your practice:  
  • standard operating procedures  
  • protocols  
  • clinical guidelines. | • Standard operating procedure, protocol and guideline, and understand the purpose of and difference between each document.  
  • Evidence base that underpins the use of procedures employed by the service. |
| 7                     | Continuously improve your practice through good practice in:  
  • identifying common sources of error  
  • identification of risk  
  • reporting critical incidents. | • The desirability of monitoring performance, internal and external quality control, learning from mistakes and adopting a no-blame culture in order to ensure high standards of care and optimise patient safety.  
  • The importance of honesty and effective apology in responding to errors of practice.  
  • The principles and practice of risk management and the effective investigation of incidents, resulting in the identification of root causes. |

**Research and Innovation**

| 8, 9                  | Participate in innovation, research, service development and audit activities, complying with guidance and laws relating to research ethics. | • The importance of innovation across healthcare science.  
  • The role of innovation in improving quality and patient care.  
  • Processes to disseminate innovation, research and audit findings.  
  • The role of the healthcare scientist and the potential impact of scientific research in your area of practice.  
  • The role of the healthcare scientist in service developments in your area of practice.  
  • Current and developing clinical practice.  
  • The effectiveness of investigations, therapies, interventions and treatments, and the mechanisms by which they contribute to patient care. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• How to horizon scan, identify and evaluate the potential role for new and innovative technologies and scientific advances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The role of the healthcare scientist and the potential impact of scientific developments, for example health prevention, genomic medicine, diagnostics and rehabilitation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The importance of public engagement in science and its role in health and society.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The legal framework relevant to informed consent and the application to clinical care, research, audit and teaching.</td>
</tr>
<tr>
<td>8, 9</td>
<td>Contribute to service and quality improvement and productivity in the work base and embed evidence-based developments within routine practice.</td>
<td>• How planning can actively contribute to the achievement of service goals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to measure and monitor performance against agreed targets.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The current structure, management, legal framework, and quality improvement structures and processes within the NHS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The current quality improvement structures and processes within the NHS and give examples of the implications for healthcare science.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Importance of self-care and shared care as part of NHS function and the impact of life-threatening and critical conditions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Principles and application of evidence-based practice.</td>
</tr>
<tr>
<td>8, 9</td>
<td>Undertake a literature review and prepare and present to peers a critical analysis of a publication from the scientific literature.</td>
<td>• How to critically analyse scientific literature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to structure and present a critical analysis.</td>
</tr>
<tr>
<td></td>
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<td>• Systems of referencing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reference manager software.</td>
</tr>
<tr>
<td>8, 9</td>
<td>Prepare and deliver an oral scientific communication to peers at a local, national, or international meeting.</td>
<td>• How to prepare an oral scientific communication.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to give an effective and timely oral presentation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How to respond to questioning.</td>
</tr>
<tr>
<td>KEY LEARNING OUTCOMES</td>
<td>COMPETENCES</td>
<td>KNOWLEDGE AND UNDERSTANDING</td>
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</tbody>
</table>
| 10                    | Lead in your clinical role through appropriate application of:  
                       - self-management  
                       - self-development  
                       - integrity  
                       - self-direction  
                       - problem solving  
                       - dealing with complex issues  
                       - making sound judgements in the absence of complete data. | - How self-awareness, self-management, self-development and acting with integrity at all times contribute to leadership.  
- The use of evidence, both positive and negative, to identify options in addressing challenges.  
- Methods of prioritising and organising academic and work based tasks to optimise own performance. |
| 10                    | Identify potential areas for change and accept change identified by others, working across different provider landscapes as required. | - Structure of the NHS.  
- The need for change, working across different provider landscapes as required.  
- Change management methodologies. |
SECTION 5: ELECTIVE LEARNING FRAMEWORK
This section describes the Learning Framework for the Elective Component of specialist work based learning, covering the Learning Outcomes, Clinical Experiential Learning, Competence, and Applied Knowledge and Understanding. This module spans the Rotational and Specialist period of training. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

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

The elective period can be taken any time during the specialist training. It may comprise a single 4- to 6-week elective or a series of shorter periods of elective training.
<table>
<thead>
<tr>
<th>MODULE TITLE</th>
<th>Elective (EL)</th>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM</td>
<td>The aim of the elective period is to facilitate wider experience of healthcare and/or the practice of healthcare science in a cultural and/or clinical setting that is different from the usual training environment. This may involve healthcare or healthcare science in a different area of the health service, or in pursuit of a particular clinical or research interest.</td>
<td></td>
<td></td>
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</tbody>
</table>
| SCOPE        | The elective provides opportunities for you to:  
|              | - explore in depth areas of particular interest beyond the scope of the Scientist Training Programme;  
|              | - increase awareness of important health issues and develop an understanding of the effect of disease on communities and individuals in different cultural contexts;  
|              | - explore unfamiliar scientific, social, economic, or cultural areas;  
|              | - become more proficient at communication with individuals from different social, cultural and ethnic backgrounds;  
|              | - gain hands-on experience that might not otherwise be possible in a Scientist Training Programme;  
|              | - design and undertake a significant assignment with appropriate guidance and supervision, thereby developing personal and organisational skills;  
|              | - undertake a small audit or research project in a different clinical setting;  
|              | - relate your experiences to your own area of practice. |

**LEARNING OUTCOMES**

Learning outcomes are specific to each student. With guidance, you are expected to identify your own educational objectives and organise an elective to achieve them.

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

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

Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Cross-Divisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Genomics</td>
</tr>
</tbody>
</table>
## GENOMICS: SPECIALIST MODULES

<table>
<thead>
<tr>
<th>Module 1 (CBI-5)</th>
<th>Programming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2 (CBI-6)</td>
<td>Advanced Clinical Bioinformatics</td>
</tr>
<tr>
<td>Module 3 (CBI-7)</td>
<td>Applied Next Generation Sequencing</td>
</tr>
<tr>
<td>Module 4 (CBI-8)</td>
<td>Information Technology for Advanced Bioinformatics Applications</td>
</tr>
<tr>
<td>Module 5 (CB1-9)</td>
<td>Whole Systems Molecular Medicine</td>
</tr>
<tr>
<td>MODULE 1</td>
<td>Programming (CBI-5)</td>
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<tr>
<td><strong>AIM</strong></td>
<td>This module will provide the trainee with the opportunity to use safe and effective software development/coding to provide solutions to issues arising within a clinical environment.</td>
</tr>
<tr>
<td><strong>SCOPE</strong></td>
<td>On completion of this module the trainee will be able to design and code using Java or an alternative object-oriented programming language, test, debug and evaluate the programme, and ensure that all documentation for each software solution is completed in accordance with local guidelines to meet laboratory accreditation and quality assurance requirements.</td>
</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Design and code a small program in Java or an alternative object-oriented programming language for bioinformatic application*, and proceed to test and debug the program in accordance with good programming practice.
2. Develop documentation and testing protocols for the program according to local practice.
3. Evaluate the program against non-functional requirements, such as maintainability, efficiency and readability, finalise the software and update and complete the documentation.

*For example for transforming large data sets, which meets simple requirements expressed in plain language.*
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- To experience and evaluate all stages of a full software development life cycle, including:
  - participate in meetings where clinical software requirements are discussed and agreed;
  - development of user specifications;
  - development of prototypes and evaluation of software;
  - system acceptance;
  - documentation, maintenance and further development;
  - laboratory quality management and quality assurance processes.
- Observe the work of a genetics service and evaluate the positive contribution of a bioinformatician, identifying the strengths and areas where the contribution could be strengthened to enhance service delivery and patient care.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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</thead>
</table>
| 1                     | Perform requirements capture within a genetic analysis team to capture functional and non-functional requirements. | • Unified Modelling Language (UML).  
• Program development paradigms.  
• Capturing requirements in plain English.  
• Object-oriented modelling.  
• Identifying actors and use cases.  
• Functional and non-functional requirements.  
• Documentation requirements. |
| 1                     | Establish a development environment and undertake program development. | • Development toolkits.  
• Establishing a virtual machine (VM) in different operating system (OS) environments.  
• Development environments, e.g. Eclipse, etc.  
• Libraries.  
• Object-oriented programming.  
• Use and extension of libraries.  
• Sources and use of specialist libraries. |
| 1, 2                  | Test, debug and evaluate the program, and perform user acceptance procedures. | • Unit testing.  
• User evaluation.  
• Iterative development.  
• User documentation.  
• Software deployment. |
| 2                     | Maintain and upgrade software solutions, ensuring compliance with quality assurance procedures, including version control. | • Version control.  
• Software version management (SVM). |
| 3                     | Evaluate the program against non-functional requirements. | • Maintainability.  
• Efficiency.  
• Readability. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Finalise the programme documentation and file in accordance with local quality assurance processes.</td>
<td>• Documentation requirements.</td>
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</table>
This module will enable the trainee to apply their knowledge of genetic variation and its role in disease in the context of bioinformatics and the wide range of tools and resources that are used in clinical bioinformatics to capture data and support patient-centred care, diagnosis and treatment. A strong emphasis will be placed on ethical and confidentiality issues with such sensitive data. An awareness of the impact of interpretations given on clinical and public health action should be paramount when communicating the analysis of data to multi-disciplinary teams.

Footnote; Form some trainees this will involve applying their knowledge of pathogen variation in bacteria and viruses and how this relates to inference of transmission and resistance to apply bioinformatics tools and algorithms to support outbreak analysis and pathogen characterisation.

On completion of this module the trainee will be able to annotate and assess variation data, undertake a range of investigations and develop an analysis strategy for a new service. Trainees will also be expected to appraise and evaluate data and work within an ethical and governance framework.

LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Annotate variation data in the context of a specific genetic investigation.
2. Develop variation data to inform a testing strategy for a specific patient population.
3. Develop an analysis strategy for a new service.
4. Advise a service with respect to the bioinformatic requirements of a new service and the strategy to deliver appropriate and clinically relevant data to support patient care.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe a range of clinical consultations where patients with genetics disorders meet with health professionals to discuss how clinical bioinformatics can be applied in the care pathway.
- With permission, identify a patient or family with a genetic disorder and discuss the impact of that genetic disorder on the quality of life of the patient and/or family with an appropriate clinical professional and reflect on how this experience will influence your future practice.
- Attend and contribute to teaching sessions where Clinical Scientists are being instructed in the correct use of existing bioinformatic analysis procedures and review/report the procedures, the use of standard operating procedures and the process of interaction with Clinical Scientists.
- Attend and contribute to multidisciplinary meetings at which the results of genetic investigations are discussed and reflect on the process, the weighting placed on different types of data, and the effect on patients’ results and care pathway.
- Visit other pathology settings where clinical bioinformatics and genomics are increasingly being used to develop strategies for identification, diagnosis and treatment, and reflect on the future contribution of clinical bioinformatics to pathology services.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Annotate variation data in the context of a specific acquired or inherited disease or genetic investigation. | • The challenges of variant identification, including single-nucleotide polymorphisms (SNPs) and copy number variants (CNVs).  
• Variation databases, e.g. dbSNP, DECIPHER.  
• SNP annotation challenges.  
• SNP resources in the major genome sequence repositories, e.g. Ensembl, UCSC.  
• Feature identification, including SNP analysis and transcription factor binding sites.  
• Missense analysis, e.g. Align GVGD, SIFT, PolyPhen, Panther, PhDSNP, MAPP.  
• Splicing analysis applications, e.g. GeneSplicer, MAxEntScan NNSplice, SSFL, HSF, NetGene2.  
• Classifying phenotype: London Database of Dysmorphology (LDD), Human Phenotype Ontology (HPO), ICD, Orphanet, Snomed-CT.  
• Application of standard operating procedures as part of the laboratory management process. |
| 1, 2                  | Use appropriate literature to summarise the role of clinical genetics in personalised healthcare in a written report or oral presentation. | • Interpret evidence from bioinformatic tools and resources and integrate this into the sum of genetic information for the interpretation and reporting of test results from patient and/or environmental samples  
• Gene dossier process.  
• Ethical and governance frameworks. |
| 2                     | Document the analysis process to annotate variation data in the context of a specific genetic investigation and use this to develop an enhanced testing strategy. | • Identify, acquire and process appropriate genetic data sets for clinical use.  
• The relevance and limitations of data from specific resources to the case(s) of interest, the influence of interfaces on the results and the limitation of methods used to validate data submissions. |
<p>| 3, 4                  | Explain how to choose and apply major bioinformatic resources for clinical diagnostics in this disease/service area and how their results are integrated with other lines of evidence to produce |                                                                                                               |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
<td>clinically valid reports.</td>
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</tr>
<tr>
<td>3, 4</td>
<td>Develop a strategy to modify or assemble tools, pipelines and processes for this disease/service area.</td>
<td>• Summarising, evaluating and interpreting data governance, patient confidentiality and legal frameworks regarding bioinformatics analysis strategy.</td>
</tr>
<tr>
<td>3, 4</td>
<td>Develop an implementation plan for the recommended strategy in the service/disease area.</td>
<td>• Provision of strategic advice to clinical genetics service leaders in developing strategies for new clinical/disease services.</td>
</tr>
</tbody>
</table>
## AIM
This module will enable the trainee to gain experience of the use of Next Generation Sequencing in a clinical setting and apply their theoretical knowledge, developing the trainees’ understanding of genome technology, the techniques needed to follow best practice in assembling genomic data from the current version of these technologies, and the tools and strategies for converting these data into clinically useful information within an ethical and data governance framework.

## SCOPE
On completion of this module, the trainee will be able to use a range of tools required to perform Next Generation Sequencing and analyse and interpret data. Trainees will gain experience in clinical settings and participate in multidisciplinary meetings. The learning outcomes and competences can be achieved in a range of settings, including clinical genetics, microbiology, virology and clinical diagnostics.

### LEARNING OUTCOMES

On successful completion of this module the trainee will:

1. Use the tools required for each stage of Next Generation Sequencing (NGS) data analysis.
2. Analyse NGS data through base calling, filtering, quality control, data validation and read mapping (eukaryotic and prokaryotic) in a clinical setting.*
3. In partnership with the relevant clinical specialist interpret NGS data through SNP, InDEL and CNV analysis, and relate to phenotypic data.

*The clinical setting could include Clinical Genetics, Microbiology, Virology, Clinical Diagnostics (for example targeted oncology treatments/classical genetics or a public health laboratory.*
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Observe the pre- and post-analytical processes from sampling to data generation and critically evaluate the process during discussions with your training officer.
- Observe the use of NGS in a range of NHS and other settings (for example academic, commercial) and evaluate commercial tools versus open-source software for analysing NGS data and the requirement for automated NGS data analysis pipelines.
- Attend a range of clinical settings where patients will be reviewed and the results generated from next generation sequence testing will be discussed with the patient, and evaluate the requirement for best practice, reproducible NGS bioinformatics, reporting workflows and the need to be able to share NGS data in the clinical setting.
- Attend and actively participate in multidisciplinary group meetings to inform and influence decisions on patient care and technology strategy.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1                     | Produce a functional FastQ file from multiple NGS platforms. | • NGS file formats and interpretation.  
• SAM tools and NGS file formats, alignment tools. |
| 1                     | Generate an aligned Binary Alignment/Map (BAM)/Sequence Alignment/Map (SAM) file. |  |
| 1                     | Produce a written report, oral, or poster presentation on outcomes and recommendations for tool usage. |  |
| 2                     | Perform quality control, data validation (on eukaryotic and prokaryotic data) using open-source and or commercial tools. | • Quality metrics for NGS data.  
• Open source and commercial NGS tools.  
• Ethical and governance frameworks. |
| 2                     | Perform appropriate analysis, e.g. mapping to reference, de novo assembly. | **Next Generation Sequencing platforms**  
• The genome science behind NGS – random fragments, sequencing, assembly.  
• Different sequencing platforms and the physical technologies they deploy, including semiconductor, optical, nanopore.  
• Applications of NGS. |
| 2                     | Identify and visualise target genomic regions. | **Sequence assembly**  
• The problems of aligning short reads.  
• Next generation alignment strategies, e.g. Bowtie, Short Oligonucleotide Analysis Package (SOAP), Burrows-Wheeler Alignment (BWA), de Bruijn graphs.  
• Data formats for next generation data, e.g. BAM, SAM, fastq.  
• Sequence interpretation.  
• SNP detection, CNV detection.  
• Oral and written communication skills. |
<p>| 2                     | Communicate findings to technical and non-technical audiences. |  |
| 3                     | Perform sequence | • Quality metrics. |</p>
<table>
<thead>
<tr>
<th></th>
<th>interpretation/reporting within quality control parameters, responding to clinical queries as appropriate.</th>
<th></th>
</tr>
</thead>
</table>
| 3 | Assign interpreted and called mutations with regard to clinically actionable events and assist in multidisciplinary direction of clinical pathway. | • Oral communication skills.  
• Relational database management systems, e.g. POSTgres, Oracle.  
• External genomic databases, e.g. Single-Nucleotide Polymorphisms Database (dbSNP). |
| 3 | Produce data in a common format compatible with NHS data standards and data-sharing protocols. | • NHS informatics standards. |
| 1, 2, 3 | Compare workflows specifically for the requirements of NGS data. | Data handling and data governance  
• Workflows for next generation analysis.  
• Data quality in next generation data.  
• Presenting next generation data.  
• Models of use of next generation technology within the NHS.  
• Issues of patient consent and what analyses are ethical. |
## MODULE 4
**IT for Advanced Bioinformatics Applications (CBI-8)**

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

### AIM
In this module trainees will be expected to use computational methodologies for handling and integrating large data in accordance with data description standards (through ontologies) and data federation standards. They will be expected to use and design dynamic systems as tools for industrial-scale bioinformatics analyses within the ethical and governance issues raised by using such technologies within an NHS setting from the perspective of the patient, the clinical department and the organisation.

### SCOPE
On completion of this module the trainee will be able to deploy dynamic systems for clinical diagnostic analysis in a clinical setting, and develop and present a strategy for an identifiable clinical bioinformatics requirement within an ethical and governance framework.

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

1. Identify a clinical and/or laboratory bioinformatics requirement and develop, validate and deploy a bespoke workflow for clinical or public health analysis.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Work within clinical teams and clinical settings using clinical bioinformatics as part of routine service and service development, and critically evaluate the current and future role of clinical bioinformatics from the perspective of the patient, the department and the healthcare organisation.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify a task capable of automated workflow analysis.</td>
<td>• How to develop a data and meta-data capture strategy for a genomics laboratory.</td>
</tr>
<tr>
<td>1</td>
<td>Carry out a feasibility study, discussing user requirements, and develop a detailed requirements specification with key stakeholders, and validate and gain authorisation.</td>
<td>• How to perform a strategic analysis of the computational requirements of a genomics laboratory through the use of computational analysis and design tools, e.g. structured systems analysis and design method (SSADM).</td>
</tr>
<tr>
<td>1</td>
<td>Perform, evaluate and present an options appraisal of technology and resource options.</td>
<td>• How to evaluate computing solutions for their fitness for purpose within the security and IT governance frameworks of the NHS.</td>
</tr>
<tr>
<td>1</td>
<td>Develop, test and evaluate the workflow and perform user acceptance procedures.</td>
<td>• How to evaluate data integration strategies for their fitness for purpose within the security and IT governance frameworks of the NHS.</td>
</tr>
<tr>
<td>1</td>
<td>Deploy the workflow, including maintenance and upgrading, ensuring compliance with quality assurance procedures, including version control.</td>
<td>• How to create simple workflows capable of integrating and analysing clinical functional genomics data.</td>
</tr>
</tbody>
</table>
| 1                     | Finalise workflow documentation and file in accordance with local standard operating procedures. | **Computational infrastructure**  
• Data encryption and data encryption standards.  
• Governance and security issues for large data in the NHS.  
• Basic cloud computing architectures (software as service, compute as service, etc.).  
• Public and private cloud architectures (including commercial systems such as Azure and EC2).  
• A basic introduction to workflows in computer science.  
• An introduction to workflow tools (Taverna, Galaxy, etc.).  
**Functional genomics and genomics data sets**  
• The concept of meta-data.  
• The role of minimum information standards to allow effective sharing.  
• Tools to capture minimal information data (Extensible Markup Language; XML).  
• An introduction to ontologies. |
<table>
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</table>

- Community annotation through ontology.
- Interoperating with ontologies.
- Strategies for large-scale data integration and data mining.
- The pros and cons of data warehouses versus data integration over distributed heterogeneous data.
- Examples of ontology-driven data integration.
- Examples of data warehouses for genomic integration (Ensembl).

**Workflows**
- The basic theory of computational workflows.
- The architecture of workflow systems.
- Examples of workflows in genetics (Galaxy assembly of NGS data).
- Analysis of current literature and data integration and workflows in genetics and medicine.
<table>
<thead>
<tr>
<th>MODULE 5</th>
<th>Whole Systems Molecular Medicine (CBI-9)</th>
<th>COMPONENT</th>
<th>Specialist</th>
</tr>
</thead>
</table>

**AIM**
This module will enable the trainee to gain experience of the process and application of the skill of literature searching and the use of bioinformatic resources within a clinical setting. This module will enable the trainee to develop and strengthen their mathematical and modelling skills and introduce them to functional genomics and systems biology strategies and the ways in which they can be applied in medicine for improved patient care within an ethical and governance framework.

**SCOPE**
On completion of this module, the trainee will be able to critically evaluate the literature and bioinformatic resources to identify biological pathways in which gene(s) may be involved and link to a specific disease process and develop those pathways.

**LEARNING OUTCOMES**

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

1. Critically evaluate the literature and bioinformatic resources to identify biological pathways in which a gene(s) could participate.
2. Critically evaluate the literature and bioinformatic resources to identify biological pathways that play a role in a specific disease process e.g. host/pathogen interactions.
3. Develop pathways and network data to inform a service development and enhance testing strategy for a specified population.
**CLINICAL EXPERIENTIAL LEARNING**

The clinical experiential learning for this module is:

- Work with a clinical team(s) to identify current knowledge and understanding of specific clinical disorders and reflect on the role of clinical bioinformatics within a clinical service.
- Observe the use of clinical bioinformatics in a range of settings, for example research, industry, or mainstream medicine, and discuss the impact of clinical bioinformatics on the prevention and treatment of disease, identifying your learning needs and developing an action plan to address them.
- Based on your clinical experiential learning, discuss with your training officer how to bridge the potential gap between molecular medicine and clinical medicine.
- Attend a local research meeting and present and defend the service development you have proposed, reflecting and responding to feedback from colleagues.

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

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

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Select a gene and perform a thorough literature search.</td>
<td>• Robust and reproducible mechanisms for recording literature searches.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Bioinformatics pathway tools</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Databases of metabolic networks (KEGG, Panther, etc.).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Databases of gene interactions (String, etc.).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gene ontology and pathway analysis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Strategies for determining whether a pathway is over-represented in a set of genes (Fisher exact t-test, methods based on gene lists).</td>
</tr>
<tr>
<td>1</td>
<td>Identify bioinformatic resources for gene interactions and networks.</td>
<td><strong>Systems biology</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Introduction to Systems Biology Markup Language (SBML).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Repositories of pathway models.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Determining model parameters from the literature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stability analysis of ordinary differential equations (ODE) models (Jacobians).</td>
</tr>
<tr>
<td></td>
<td>Identify biological pathways in which gene(s) operate.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Critically evaluate and integrate all information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Produce a written summary of reference sequences and single-nucleotide polymorphisms (SNPs) within networks with phenotype information.</td>
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<tr>
<td></td>
<td>Identify and evaluate current state-of-the-art resources as appropriate.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Identify a disease area of interest following discussions with clinical teams, and perform a literature search around clinical phenotype, including any clinical databases.</td>
<td>• Robust and reproducible mechanisms for recording literature searches.</td>
</tr>
<tr>
<td></td>
<td>Interrogate a range of bioinformatic resources for disease pathway interactions.</td>
<td>• Computational disease resources such as OMIM, GeneReviews.</td>
</tr>
<tr>
<td></td>
<td>Critically evaluate and integrate all information.</td>
<td>• Computational interactional resources for gene-gene, e.g. String.</td>
</tr>
<tr>
<td></td>
<td>Produce a written summary of the biological pathways with phenotypic information.</td>
<td>• Tools for identifying pathways that are over-represented in gene lists.</td>
</tr>
<tr>
<td></td>
<td>Identify and evaluate current state-of-the-art resources as appropriate.</td>
<td>• How to develop hypotheses around the potential phenotype of a mutation based on an analysis of the pathways and interactions in which it could participate.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
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<tbody>
<tr>
<td></td>
<td>of-the-art resources as appropriate.</td>
<td>disease-specific mutations from NGS data.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provision of strategic advice to clinical genetics service leaders in developing systems strategies for interpreting next generation and other large-scale sequencing data.</td>
</tr>
<tr>
<td>3</td>
<td>Use network strategies from learning outcomes 1 and 2 to develop an enhanced testing strategy.</td>
<td>• Gene Dossier process.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ethical and governance frameworks.</td>
</tr>
<tr>
<td>3</td>
<td>Determine if pathway-based gene testing is appropriate.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Document the analysis process, justify the recommendation and proposed gene panel (if recommended).</td>
<td></td>
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</tbody>
</table>
SECTION 7: SPECIALIST LEARNING FRAMEWORK: PHYSICAL SCIENCES
This section describes the Learning Framework for the **Specialist Component** of work based learning covering the Learning Outcomes, Clinical Experiential Learning, Competence and Applied Knowledge and Understanding. Each trainee is also expected to build on and apply the knowledge, skills and experience gained from the MSc in Clinical Science.

### Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Cross-Divisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
</tr>
<tr>
<td>SPECIALISM</td>
<td>Physical Sciences</td>
</tr>
</tbody>
</table>
## CLINICAL BIOINFORMATICS FOR THE PHYSICAL SCIENCES: SPECIALIST MODULES

<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1 (DD-1)</td>
<td>The Project Life Cycle</td>
</tr>
<tr>
<td>Module 2 (DD-2)</td>
<td>Advanced Information and communications technology Skills</td>
</tr>
<tr>
<td>Module 3 (DD-3)</td>
<td>Database Management, Data Mining and Modelling</td>
</tr>
</tbody>
</table>
MODULE 1  |  The Project Life Cycle (DD-1)  |  COMPONENT  |  Specialist
--- | --- | --- | ---
**AIM** | This module will provide the trainee with in-depth experience of the project life cycle by implementing a project or range of projects within the context of a formal project management methodology. | | |
**SCOPE** | On completion of this module the trainee will be able to develop, critically evaluate and implement novel (ICT) projects within the Physical Sciences. The trainee will take part in a project life cycle process from the concept stage right through to design and development and validation. | | |

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Implement an innovation and development project within the context of a formal project management methodology.
2. Agree the clinical need for the project with other scientists, clinicians, patients and/or service users.
3. Evaluate the current state of the art and limitations of existing solutions.
4. Develop a specification of requirements for the project.
5. Develop, critically evaluate and deliver novel (ICT) projects within the Physical Sciences.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Critically review one or more completed projects within their organisation, including the clinical and scientific background, and the potential benefit to the service and safe patient care; discuss with colleagues the development life cycle and suggest alternatives and/or improvements.
- Critically review one or more ongoing projects within their organisation, including the clinical and scientific background, and the potential benefit to the service and safe patient care; be able to identify the stage in the development life cycle the projects are at and develop proposals to progress each project.
- Undertake a new project or projects, applying the life cycle process from the concept stage through to design, development, validation and verification, relating to a clinical application in the Physical Sciences.
- Work with clinical colleagues to develop a prototype clinical application, pilot the prototype and present the work, including the plan for implementation to clinical colleagues.
- Experience and evaluate all stages of the project life-cycle, including:
  - development of draft project specification;
  - participation in meetings where the project requirements are discussed and agreed;
  - development of user specifications;
  - development of prototypes and evaluation of software;
  - project acceptance;
  - documentation, maintenance and further development;
  - quality management and quality assurance processes.
- Observe the work of a clinical service and evaluate the positive contribution of a Clinical Scientist working in Clinical & Scientific Computing for the Physical Sciences, identifying the strengths and areas where the contribution could be strengthened to enhance service delivery and patient care.
- Attend a local research meeting and present and defend the project you have undertaken, reflecting and responding to feedback from colleagues.

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

The following section details the competence and knowledge and understanding each trainee must gain. Each competence is linked to the relevant learning outcomes and trainees must demonstrate achievement of each competence for each linked learning outcome.
PROFESSIONAL PRACTICE
Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</tr>
</thead>
</table>
| 1                    | Devise a plan using an appropriate project management methodology to successfully deliver an innovation and development project, controlling the quality, timing and costs of activities. | • The process of the project life cycle.  
• Appropriate formal project methodologies and their application.  
• Factors influencing control of quality, timing and costs.  
• An understanding of how these limiting factors are derived and quantified.  
• The requirements for project plans, dependencies and the critical path.  
• Nomenclature in project documentation. |
| 2, 4                 | Work with users to develop a detailed specification of requirements for an innovation and development project. | • The technical, scientific and clinical basis of the clinical measurement or problem being addressed.  
• The requirements for project specifications, including different ways of presenting them.  
• Derivation of hazard log and risk analysis.  
• Production of a safety case statement.  
• An appreciation and understanding of the range of users for whom this solution is designed. |
| 3, 4                 | Design a solution to meet the previous point by formulating various options and critically appraising them, taking into account the requirements specification, appropriateness of development tools and sustainability in the proposed operational environment. | • Sound knowledge of software engineering principles and ICT skills and their applications in the Physical Sciences and clinical problem solving.  
• The design tools and packages available.  
• Appropriate programming languages (e.g. C++, Matlab, IDL, Java, .NET).  
• Relevant knowledge of mathematical modelling, statistical modelling, data conditioning or modelling, and analysis techniques.  
• Critical evaluation and appraisal of options and solutions.  
• The use of development tools (computer programming, CAD, |
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<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
|                       | including signal processing, decision support, mathematical modelling and choice of development platform. | modelling systems, etc.) and their selection and application.  
|                       | A review of factors affecting sustainability in the operational environment. |
| 5                     | Develop and undertake a validation plan. | The process of the project life cycle.  
|                       | The requirements for a validation plan and an understanding of how this plan validates the project.  
|                       | The requirements for a verification plan and the difference between verification and validation. |
| 5                     | Develop and undertake a verification plan. | Effective written communication, including presenting technical information for both technical and non-technical users.  
|                       | Presentation of information for a range of users and purposes, including providing information, training and general reference.  
|                       | Development of technical information to enable support of the solution by a third party. |
| 5                     | Develop user documentation and training. | The relevant range of standards and their application (ISB 0129, MDD, 80001, IEC 62304:2006 and EN14971, etc.).  
|                       | Relevant development methodologies (e.g. Waterfall, Agile) and their comparative merits and applicability.  
|                       | The practical relevance and implementation of safety standards (see above list).  
|                       | Risk analysis methods and techniques, including hazard workshops.  
|                       | How to implement risk management standards.  
|                       | The practical implications of clinical governance issues related to medical devices.  
|                       | The practical implications of research governance issues |
| 5                     | Develop technical documentation. | Follow the requirements of an appropriate development methodology.  
| 1, 5                  | Manage a project within the framework of a formal project management methodology. | Manage security, safety and business risk throughout the development.  
<p>| 5                     | Manage security, safety and business risk throughout the development. | Apply risk analysis iteratively to improve and redefine a design. |</p>
<table>
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<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
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<tbody>
<tr>
<td></td>
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<td>related to clinical software.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Factors affecting security, safety and business risk, and how they influence the final design.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• When registration of the solution is required and by whom.</td>
</tr>
<tr>
<td>5</td>
<td>Perform end-stage review.</td>
<td>• How to critically appraise the project following completion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compile a ‘lessons learned’ report to inform future work.</td>
</tr>
</tbody>
</table>
**MODULE 2**

<table>
<thead>
<tr>
<th>Advanced Information and communications technology Skills (DD-2)</th>
<th>Component</th>
<th>Specialist</th>
</tr>
</thead>
</table>

**AIM**
To ensure that the trainee can apply Information and communications technology (ICT) hardware and software solutions safely within a clinical environment.

**SCOPE**
On completion of this module the trainee will be able to safely configure and implement an ICT project in the Physical Sciences, including both hardware and software elements.

**LEARNING OUTCOMES**

On successful completion of this module the trainee will:

1. Configure ICT hardware, software and network components, applying relevant safety standards and configuration control.
2. Implement server-based applications, ensuring appropriate security, protective measures and routine housekeeping tasks.
3. Implement an application or major upgrade in the clinical environment in a controlled fashion.
4. Utilise appropriate healthcare ICT standards.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Critically review one or more existing systems for compliance with Information Governance Toolkit.
- Work with colleagues on the deployment and management of ICT systems within the Physical Sciences.
- Support clinical colleagues in the integration of ICT systems, such as the integration of medical devices into patient management systems.
- Undertake the administration of a local area network (user specification; initial set-up; shared resources; security issues, resilience and data backup and retrieval).
- Work within clinical teams and clinical settings using ICT as part of routine service and service development, and critically evaluate the current and future role of ICT from the perspective of the patient, patient safety, the department and the healthcare organisation.

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

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

PROFESSIONAL PRACTICE

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</thead>
</table>
| 1                     | Discuss and agree the operation of major ICT hardware, software and networking components. | • Local area networks and TCP/IP.  
• The requirements of a medical IT network as defined in 800001-1.  
• Requirements for implementation and factors influencing decisions.  
• Key factors affecting security management.  
• The range of routine housekeeping tasks associated with standard server-based operating systems.  
• An appreciation of the difference between server- and client-side applications and when each is appropriate to deploy.  
• The difference between standard software components.  
• The appropriate selection of software tools, e.g. do not use a spreadsheet as a database or a database as a word processor.  
• Data exchange protocols.  
• Data exchange standards - Digital Imaging and Communications in Medicine (DICOM) and Health Level 7 (HL7).  
• Links to hospital administration systems. |
| 1                     | Deploy and configure a DICOM and/or HL7 interface. | |
| 1, 2                  | Undertake implementation of at least one standard server-based operating system, including security management and routine housekeeping tasks. | • IT security and data integrity.  
• The range of relevant safety standards and guidance and its application.  
• Factors influencing data integrity and their implications.  
• Awareness of governance issues relating to patient data: data loss prevention.  
• Awareness of the concept of a system in the context of electrical safety.  
• The governance issues relating to patient data, including appropriate legislation.  
• Protective measures for ICT systems and their appropriate application.  
• Limitations imposed on safety and integrity by the US Food and |
<p>| 1                     | Apply relevant safety standards and guidance for the use of computers in clinical practice, including electrical safety. | |
| 2                     | Develop and maintain protective measures for ICT systems, including disaster measures, antivirus protection, maintenance, updating, firewalls and virtual servers/networks. | |
| 4                     | Critically appraise the ICT standards adopted by the NHS, including Digital Imaging and | |</p>
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Communications in Medicine (DICOM) and Health Level 7 (HL7).</td>
<td>Drug Administration (FDA) and the EU Medical Devices Directive (MDD) and an appreciation of the techniques used to mitigate the risk this introduces.</td>
<td></td>
</tr>
</tbody>
</table>
| 3 Plan and carry out the implementation of ICT components in a controlled fashion, taking into account the impact on existing facilities and clinical service. | • Use of computing in the context of Medical Physics and Clinical Engineering.  
• The use of commonly available databases, spreadsheets and statistics packages (e.g. MS SQL, mySQL, SPSS, Excel, Minitab, SAS, R).  
• Appropriate programming languages (e.g. C++, Matlab, IDL, Java, .NET).  
• The use and application of web development tools and the use and application of client-side scripting such as JavaScript.  
• The potential influences/advantages/disadvantages of implementation on data management, taking into account appropriate legislation, local policy and the EU Medical Devices Directive (MDD). |
### MODULE 3
**Database Management, Data Mining and Modelling (DD-3)**

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<th>Component</th>
<th>Specialist</th>
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#### AIM
This module will enable the trainee to design and develop a database, undertake data mining using a large data set, summarise and present the data, and develop models for biological systems.

#### SCOPE
On completion of this module the trainee will be able to work with a range of database, data mining and data modelling tools (e.g. Monte Carlo, pharmacokinetic modelling, neural networks and finite element analysis) and apply them to problems not previously encountered by the trainee.

### LEARNING OUTCOMES

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

1. Develop a database structure to meet a clinical need.
2. Implement SQL and data mining strategies on a large data set.
3. Summarise and present data from large datasets.
4. Develop models for biological systems, e.g. compartmental modelling in Nuclear Medicine.
CLINICAL EXPERIENTIAL LEARNING
The clinical experiential learning for this module is:

- Observe a range of large databases/data sets in use in the hospital setting and critically evaluate their use in discussions with your training officer.
- Work with a clinical team to specify and implement a relational database.
- Observe the use of large data sets to inform clinical care through the use of data mining techniques.
- Work with a large data set to summarise and present the outcome of data mining to colleagues.
- Work with a clinical team to develop a computational model of a biological or physiological system using, for example Monte Carlo, pharmacokinetic modelling, neural networks, or finite element analysis.

PROFESSIONAL PRACTICE
Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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<th>KEY LEARNING OUTCOMES</th>
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</table>
| 1, 2                  | Creation of a relational database in 3rd normal form, including appropriate data typing, precision and the use of structured coding schemes. | Database management and data mining  
- The relational model of data.  
- Implementation of relational databases.  
- Advanced SQL programming.  
- Query optimisation.  
- Concurrency control and transaction management.  
- Database performance tuning.  
- Distributed relational systems and data replication.  
- Column store/data warehousing database engines.  
- Document oriented databases (e.g. Lucene).  
- Security considerations.  
- Data mining.  
- Large data set methodologies.  
- Database standards and standards for interoperability and integration.  
- Data analysis and presentation.  
- The use of commonly available databases, spreadsheets and statistics packages (e.g. MS SQL, mySQL, SPSS, Excel, Minitab, SAS, R). |
<p>| 2                     | Analyse requirements and produce database schema, understanding information access profiles and indexing. |<br />
| 1                     | Implement a disaster recovery strategy, including resilience security backup and production of both Disaster Recovery (DR) and Business Continuity (BC) plans. |<br />
| 1                     | Risk assess a commercially supplied database supplied as part of a clinical system, including Disaster Recovery (DR) and Business Continuity (BC) planning. |<br />
| 2, 3                  | Through use of data mining or modelling tools on a large or complex data set critically evaluate their potential value to the clinical service. |<br />
| 2, 3                  | Summarise data from a large or complex data set and present the results. |<br />
| 4                     | Construct a computational model of a physiological or biological process | Modelling biological systems |</p>
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</table>
| 4                     | Validate the operation of a commercial/open source physiological or biological model. | • Analysis of DNA, protein, biological diversity and molecular interaction data.  
  • Use of bioinformatics and systems biology databases.  
  • Data sources and data synthesis.  
  • Detailed knowledge and understanding of algorithms in bioinformatics and theoretical systems biology.  
  • Monte Carlo modelling.  
  • Compartimental modelling.  
  **Software techniques**  
  • Neural networks and their applications.  
  • Artificial intelligence and expert systems.  
  • Image processing software, including image reconstruction and registration.  
  • Finite element analysis.  
  • Genetic algorithms. |
SECTION 8: SPECIALIST LEARNING FRAMEWORK: HEALTH INFORMATICS SCIENCE
STP Learning Framework

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

### Specialist Modules

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>Cross-Divisional</th>
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<tbody>
<tr>
<td>THEME</td>
<td>Clinical Bioinformatics</td>
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<tr>
<td>SPECIALISM</td>
<td>Health Informatics Science</td>
</tr>
<tr>
<td>Module 1 (HI-1)</td>
<td>Policy, Strategy and Operational Management</td>
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<td>--------------------------------------------</td>
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<tr>
<td>Module 2 (HI-2)</td>
<td>Co-Production of Health</td>
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<tr>
<td>Module 3 (HI-3)</td>
<td>Systems Development and Design</td>
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<tr>
<td>Module 4 (HI-4)</td>
<td>Information and Knowledge Management</td>
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AIM
During this module trainees will be expected to contribute to, write and deliver policy and strategy aimed at ensuring safe, secure, high-quality, effective patient-centred services. Trainees will be expected to apply and develop their knowledge and understanding of the organisational aspects relating to the use and application of health informatics science within the health and care context and solve problems. This will include the key factors influencing operational management and running of informatics services in the health and social care sectors; and of the frameworks and processes required for the effective management and delivery of an operational service. All activities in this module will be focused on patient care outcomes, including patient safety.

SCOPE
On completion of this module the trainee will be able to determine how any local informatics strategy is, or can be aligned to national policy and strategy, and develop such if required. They will also gain experience by shadowing or assisting colleagues in day-to-day work; and will be required to critically reflect and analyse this experience, making recommendations as to how to improve service management practice and stakeholder engagement as part of continuous service improvement. Trainees will be expected to continue to develop their professional practice.

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

1. Review and critique one organisation’s informatics strategy and its relationship to national health and care policy and strategy, including how patient care outcomes and patient safety are addressed.
2. Shadow at least two senior managers and critically reflect on specific service management practices.
3. Present and defend observations and views on either or both of these activities at a meeting with peers.
4. Appraise the role of stakeholders and stakeholder engagement in a local informatics strategy, and its implementation, and present a written report with recommendations for future engagement strategies, including an implementation plan.
CLINICAL EXPERIENTIAL LEARNING

The clinical experiential learning for this module is:

- Assist an informatics lead in one of the following activities within their organisation: (i) developing or (ii) modelling or (iii) implementing an informatics policy and/or strategic plan, and critically reflect on the process, identifying your additional learning needs and how you will use this experience in your future practice.
- Identify instances where ICT/technical strategies have failed, what revisions to the plan were implemented, and evaluate why and how they failed and what lessons can be learnt, and discuss these with your training officer.

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

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

PROFESSIONAL PRACTICE

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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| 1, 2, 3, 4            | Apply information governance principles and best practice in the workplace, including confidentiality. | • The legislation, regulatory guidance and NHS protocols regarding the security, confidentiality and appropriate sharing of patient identifiable information.  
• Role of the Caldicott Guardian.  
• The different arrangements and the associated responsibilities of clinical staff for security of all types of clinical information, especially electronically held, and for using such data for ‘secondary’ purposes.  
• Key current health and care policies and the associated strategies, and in particular those relating to patient outcomes and patient safety. |
| 1                     | Critically review an organisation-wide informatics strategy, including issues of patient care and safety and how it relates to national policy and strategy and the underpinning evidence base. | • Policy and strategy development life cycles.  
• Key current health and care policies and the associated strategies.  
• The history of informatics development in the NHS and lessons learnt.  
• Strategy analysis methodologies (such as SWOT, PEST and Four Corners, etc.).  
• Governance – structures, types and levels of authority, accountability and responsibility for health and care service delivery and outcomes.  
• The structure and content of effective strategies.  
• The principles of critical appraisal. |
| 1                     | Write a short written report identifying the alignment of the strategy to national policy and strategy, document your findings and make recommendations to a head of | • Strategic recommendations and report writing principles.  
• Critical thinking principles.  
• Information (structured and unstructured) interpretation and analysis techniques. |
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<td>department to solve any problems identified.</td>
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<tr>
<td>1</td>
<td>Summarise findings and present these to peers and colleagues, responding to questions.</td>
<td>• Effective communication and presentation principles.</td>
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<tr>
<td>2</td>
<td>Shadow at least two senior managers and critically reflect on the impact of service management practice.</td>
<td>• Differences and links between leadership and management.</td>
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<tr>
<td></td>
<td></td>
<td>• The principles of good service management.</td>
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<tr>
<td></td>
<td></td>
<td>• Leadership: behaviours, styles, skills, types, impact on performance.</td>
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<tr>
<td></td>
<td></td>
<td>• Management theory: behaviours, styles, skills, types, impact on performance.</td>
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<td></td>
<td></td>
<td>• The nature and impact of organisational culture on service delivery practice.</td>
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<td>• Tools and techniques to measure, analyse and improve efficiency, effectiveness and productivity.</td>
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<tr>
<td>2</td>
<td>Critically analyse the experience of shadowing senior managers and discuss your conclusions and experience with your supervisor in a structured manner.</td>
<td>• Comparison approaches and techniques.</td>
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<td></td>
<td></td>
<td>• Handling difficult and sensitive matters.</td>
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<td>• Effective meeting principles.</td>
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<td></td>
<td></td>
<td>• Operational management and effective management practices – how they can be applied to informatics services within the health and care sector.</td>
</tr>
<tr>
<td>3</td>
<td>Appraise and critically review the role of stakeholders and stakeholder engagement in a local informatics-related strategy’s development and its implementation.</td>
<td>• Stakeholder engagement analysis and profiling.</td>
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<td>• Stakeholder engagement plans and strategy development and its implementation – benefits and challenges.</td>
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<td></td>
<td></td>
<td>• Management of and communication with stakeholders.</td>
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<td>• Engagement and inclusion methods and approaches.</td>
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<td></td>
<td></td>
<td>• Stakeholder impact on commissioning and delivery of (informatics) services.</td>
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</table>
|                      |             | • Critical appraisal and comparison with other available/accessible strategies.  
|                      |             | • Engaging and including vulnerable and hard-to-reach groups and individuals.  
| 3                    | Meet with and seek the views of a cross-section of stakeholders, including patients/patient groups.  
|                      |             | • Effective communication strategies.  
|                      |             | • Survey methodologies and techniques.  
|                      |             | • Questionnaire design and the impact of contrasting and diverse points of views.  
|                      |             | • Patient-centred care.  
|                      |             | • Integrated care.  
|                      |             | • The impact of informatics on service outcomes, quality and efficiency.  
| 3                    | Write a report on findings, making recommendations for future engagement strategies to head of department and/or the chief information officer and/or chief clinical information/informatics officer.  
|                      |             | • Data and information (structured and unstructured) interpretation and analysis techniques.  
|                      |             | • Effective communication and presentation techniques.  
|                      |             | • Report writing.  
|                      |             | • Strategic recommendations writing principles.  |
### MODULE 2 | Co-Production of Health (HI-2) | Component | Specialist
--- | --- | --- | ---
**AIM** | During this module, trainees will be expected to contribute to, write and deliver policy on the provision of information for patients/public and on patient/public-accessible systems. Trainees will be expected to apply and develop their knowledge and understanding of the patient perspective on the use and application of health informatics science within the health and social care context. This will include the key factors in the co-production of health and care between patients/public and healthcare services, and the role of technology in these relationships. | |  
**SCOPE** | On completion of this module the trainee will be able to determine how the informatics strategy for their host organisation fits with patient/public needs and their existing behaviour. They will also gain experience by shadowing or assisting colleagues and will be required to critically reflect and analyse this experience and make recommendations as to how to improve the co-production of health and care as part of continuous service improvement. Trainees will be expected to develop their professional practice. | |  
**LEARNING OUTCOMES**

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

1. Critically evaluate a patient information/engagement strategy (a strategy developed by a clinical team or an organisation to provide information to or otherwise engage with a particular patient/carer group) with particular reference to how patients were included in the development and how they have used the information or other resources.
2. Perform an audit of resources available for patients, evaluate and present the results within a multidisciplinary team and set out an action plan to address issues identified and discuss the role of audit in quality management within the clinical setting.
3. Assist in evaluating online or electronic health resources that can be used in a range of situations, including to support health professionals and patients making decisions about the use of electronic health resources for diagnosis and monitoring purposes.
4. Meet with patient(s) to discuss their views with respect to a health informatics initiative and present the outcome to your colleagues and patient representatives.
5. Advise health professionals with respect to the use of information resources/internet interventions/behaviour change apps that should be recommended to patients within your scope of practice.
CLINICAL EXPERIENTIAL LEARNING
The clinical experiential learning for this module is:

- With permission, observe healthcare professionals negotiating shared care with patients in the context of digital technology. Critically appraise the communication/interaction, seeking the views of both the patient and the health professional, and identify factors that have a positive impact on the negotiation and areas that could be improved.
- Visit a range of clinical environments in primary and secondary care, and if possible in the home environment, where patients with chronic diseases are encouraged to take an active role in their care (e.g. diabetes clinics), and identify barriers to the use of telehealth and telecare technologies and the implications for a patient in the use of wearable technology (e.g. sensor monitoring heart rate, etc.) or mobile technology (e.g. apps, etc.).
- Attend a multidisciplinary team meeting where the use of clinical information from an audit is presented and discussed, and critically reflect on the role of the Clinical Scientist within multidisciplinary teams.
- Attend multidisciplinary clinical research meetings and critically evaluate how the research outcomes will inform the critical evaluation of practice of the multidisciplinary team and your personal practice, and discuss your experience with your training supervisor.

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

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

PROFESSIONAL PRACTICE
Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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</table>
| 1, 2, 3, 4, 5         | Apply information governance principles and best practice in the workplace, including confidentiality. | • The legislation, regulatory guidance and NHS protocols regarding the security, confidentiality and appropriate sharing of patient identifiable information.  
• Role of the Caldicott Guardian.  
• The different arrangements and the associated responsibilities of clinical staff for security of all types of clinical information, especially electronically held, and for using such data for ‘secondary’ purposes. |
| 1                     | Specify the essential components of an effective patient information/engagement strategy. | • The role of information in the patient journey from a service delivery perspective, including in patient safety and behaviour change. |
| 1                     | Work with a clinical team and/or users to gain a wider view of the effectiveness of a patient information and engagement strategy, and design a solution to address any issues raised. | • The role of information in choice and shared-care from patient and professional perspectives.  
• Equity as it relates to patient information sharing and accessibility.  
• The use of technologies in health information availability.  
• How to tailor a strategic approach to health information sharing according to the needs of the intended audience.  
• The role of patients/public as providers of data and information. |
| 1                     | Critically appraise a patient information/engagement strategy. | • The application of critical appraisal skills to the evaluation of health information strategy. |
| 1                     | Present your findings to colleagues and patients, making recommendations for revision of the patient information strategy. | • Presentation techniques and tailoring for professional and patient audiences.  
• How to draft strategic recommendations. |
| 2                     | Design and carry out an audit of resources available for patients, ensuring any necessary approvals are in place. | • Audit design principles and practice.  
• Ethics and their application in information-related audits.  
• The characteristics of high-quality, effective patient information. |
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</table>
| 2                    | Analyse and interpret the data from the audit and prepare a written report, including an action plan and proposing solutions to any problems identified. | • Data analysis.  
• Report writing. |
| 2                    | Present the findings from the audit to an audience of peers. | • How to present the outcomes of an information resource-related audit to peers in an effective manner. |
| 2                    | Work within the multiprofessional team, building and sustaining professional relationships. | • Effective team working.  
• Team roles and responsibilities.  
• Confidentiality. |
| 3                    | Specify the characteristics of effective online or electronic health resources. | • The characteristics of high-quality, effective online or electronic resources.  
• The issues and challenges associated with the provision of such resources, including patient safety, use of language and accessibility.  
• The role of digital and health literacy. |
| 3                    | Design, document and undertake an evaluation of online or electronic health resources. | • Information evaluation methodologies and approaches.  
• How to appraise the quality and effectiveness of online or electronic health information resources. |
| 3                    | Appraise the approach taken and document this and the conclusions of the evaluation for presentation to peers. | • How to reflect on and critique a chosen evaluation technique.  
• The effective communication of conclusions to peers. |
<p>| 3                    | Advise health professionals and patients making decisions about the use of electronic health resources for diagnosis and monitoring purposes. |<br />
| 4                    | Write a proposal to enable you to meet | • The application of ethics approvals in patient surveys. |</p>
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|                       | with patients or patient groups to discuss their views with respect to a health informatics initiative and gain the necessary approvals. | • Survey design and proposal drafting principles.  
• Interviewing skills.  
• Listening skills. |
| 4                    | Apply an appropriate data collection method or methods. | • How to draft survey questions and manage the collection of data and information from patients.  
• Relative benefits of data collection methodologies. |
| 4                    | Analyse and present your conclusions to the owner of the initiative and to the survey’s participants. | • Data analysis techniques.  
• Presentation options for different audiences.  
• The characteristics of effective and high-quality health initiatives from a patient perspective.  
• Associated lessons, issues and challenges for clinicians and others owning health information initiatives. |
| 5                    | Critically evaluate a range of information/resources/internet/behavioural change apps and identify those that should be recommended to health professionals and patients, considering the underpinning evidence base. | • Behavioural change models.  
• Range of apps to support diagnostics and treatment. |
<p>| 5                    | Interpret data to provide diagnostic and therapeutic advice to health professionals with respect to the appropriate use of information resources/internet interventions/behaviour change apps to support diagnosis and long-term treatment plans. | |
| 5                    | Work with colleagues and within multidisciplinary teams to ensure information is used appropriately to | |</p>
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<tr>
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<td>formulate specific and appropriate management plans for patients using</td>
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<td>electronic health resources and, where appropriate, agreed timescales with</td>
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<td></td>
<td>the patient and colleagues.</td>
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AIM
Trainees will apply their detailed understanding of the different approaches to the specification, design, verification and delivery of systems to gather data to define system requirements. The trainee will apply their knowledge in a way that results in systems delivering target benefits, fulfilling user expectations, maximising patient safety and providing value for money. Trainees will be provided with an opportunity to critically appraise a current live project and make suggestions on alternative approaches that could have been adopted and how it could be improved.

SCOPE
On completion of this module the trainee will be able to produce and critically evaluate a system development and design plan to ensure it meets the needs of all stakeholders. They will also apply systems design methodologies and will be required to reflect on the process and how this could be modified for other projects. They will gain this experience by assisting colleagues and will critically reflect on the process. It is expected that trainees will develop their professional practice.

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

1. Recommend and justify a system design plan and procurement approach to an informatics lead.
2. Perform a system requirements gathering exercise, develop a specification of requirements and present findings in a functional requirement document to all stakeholders.
3. Critically appraise a systems design/development plan to determine suitability of existing services.
4. Select and apply systems development methodologies to a range of projects in the workplace, including at least one in a healthcare science setting.
5. Review the flow of information between systems and across organisational boundaries and identify how an existing (recent) project has improved outcomes.
6. Review or develop the requirements across an organisational enterprise architecture.
CLINICAL EXPERIENTIAL LEARNING
The clinical experiential learning for this module is:

- Assist an informatics lead in either (i) reviewing or (ii) developing a system design plan and/or procurement approach, evaluating each stage, and critically reflect on the process and how you will use this experience in the future.
- Apply system design methodologies to a range of projects; critically evaluate the outcomes to determine future suitability of such methodologies to system design scenarios.
- Visit a range of clinical environments in a number of organisations and identify issues surrounding information flows and systems design and the impact of them should they not be considered.

PROFESSIONAL PRACTICE
Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
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| 1, 2, 3, 4, 5, 6      | Apply information governance principles and best practice in the workplace, including confidentiality. | • The legislation, regulatory guidance and NHS protocols regarding the security, confidentiality and appropriate sharing of patient identifiable information.  
• Role of the Caldicott Guardian.  
• The different arrangements and the associated responsibilities of clinical staff for security of all types of clinical information, especially electronically held, and for using such data for ‘secondary’ purposes. |
| 1                     | Select an approach to system design for a local system change or procurement project. | • System design methodologies and their application in design, procurement and deployment of an information system.  
• Business process analysis and predictive modelling techniques.  
• Systems thinking principles.  
• System integration principles.  
• Key principles in (system) design, including accessibility and usability for disabled, vulnerable and/or marginalised individuals and communities.  
• Cognitive task analysis tools and techniques. |
| 1                     | Appraise the options for procuring the system required to meet the needs of the local project. | • Options appraisal methodologies.  
• Methods and frameworks for developing and applying business cases.  
• Project, programme and change management methodologies, tools and techniques.  
• Procurement: the acquisition of products, services, or people from an external source, including relevant rules, regulations and frameworks.  
• Contract and third party management: processes, mechanisms and frameworks for establishing, running and managing contracts with third parties.  
• Commercial models.  
• Commercial sector interface with the public sector. |
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</table>
| 1                    | Present your recommendations to a peer group and the supervisor using the correct nomenclature relating to project documentation. | • Report writing best practice.  
• Business case writing principles.  
• Presentation techniques.  |
| 2                    | Perform a system requirements gathering exercise and analyse and interpret the data, applying the appropriate quality management processes. | • The importance of accurately defining the requirements of a system.  
• Functional: what the product should do.  
• Data requirements: capture the type, volatility, size/amount, persistence, accuracy and the amounts of the required data.  
• Environmental requirements: (a) context of use; (b) social environment (e.g. collaboration and coordination); (c) how good is user support likely to be; (d) what technologies will it run on.  
• User requirements: capture the characteristics of the intended user group.  
• Usability requirement: usability goals associated measures for a particular product.  
• Data gathering techniques, including questionnaires, interviews, focus groups, naturalistic observation, studying documentation.  
• How to classify the task.  
• How to identify an appropriate stakeholder group.  
• Data interpretation and analysis.  
• Use cases.  
• Task descriptions.  
• Task analysis.  
• Requirements management.  
• Requirement of description documents.  
• Range of tools available.  
• Benefits identification and measurement.  
• Patient safety aspects of system design.  |
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<tbody>
<tr>
<td></td>
<td></td>
<td>• Usability and accessibility.</td>
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</table>
| 3                     | Critically appraise a systems design/development plan, identifying problems and risks and issues; and proposing solutions and mitigations. | • Systems design theory and methodologies.  
• Systems thinking.  
• Needs assessment.  
• Patient safety-related risks and issues and mitigations.  
• Change management theory and practice.  
• Critical appraisal methodologies. |
| 3                     | Write a report of your findings making recommendations for improvement and present these to your line manager and peers. | • Report writing good practice.  
• Presentation techniques.  
• Effective communication theory and practice. |
| 4                     | Apply systems development methodologies to a range of projects in the workplace. | • Systems analysis.  
• Systems development methodologies and their application.  
• Process mapping. |
| 4                     | Critically reflect on your experience of using systems development methodologies and share your conclusions with your line manager or supervisor. | • Critical reflection principles and practice.  
• Effective communication principles and practice. |
| 5                     | Review and document an information flow between systems and across organisational boundaries. | • Organisational structures and governance arrangements in health and in social care.  
• Barriers to systems integration.  
• Examples of good practice in systems integration across organisational boundaries.  
• Information governance and ethical issues.  
• Data and information architectures and models.  
• Clinical and patient-centred benefits of systems.  
• Clinical and safety risks and issues. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 5                     | Evaluate an existing (recent) project to determine how this has improved outcomes for patients and discuss how the learning from this might be incorporated into future systems. | • Benefits tracking and appraisal methodologies.  
• Critical appraisal methodologies and practice.  
• Knowledge management principles and practice.  
• Patient safety risk and issues, and management and mitigation. |
| 6                     | Identify instances where cross-organisational enterprise architecture has been unsuccessful and critically evaluate why this was and the lessons learnt. | • Enterprise architecture domain methodologies.  
• How to link together business needs and technical solutions.  
• Characteristics of effective cross-organisational architecture solutions.  
• Barrier to the effective cross-organisational architecture solutions.  
• Current EU projects. |
<p>| 6                     | Review or develop the requirements across organisational enterprise architecture. | |
| 6                     | Present and defend your findings in a written report and verbally to your line manager and peers. | |</p>
<table>
<thead>
<tr>
<th>MODULE 4</th>
<th>Information and Knowledge Management (HI-4)</th>
<th>Component</th>
<th>Specialist</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM</td>
<td>This module will enable the trainee to identify clinical concepts underlying healthcare activity, including healthcare science and represent them in a computable form. They will represent a clinical decision in an appropriate formalism and assess the quality of the data. Trainees will apply their understanding of what knowledge is, and how knowledge can be harnessed to improve the quality and safety of clinical care. The trainee will formally represent information and knowledge and apply decision analysis techniques to the use of large NHS data sets to inform clinical and service decision making.</td>
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</tr>
<tr>
<td>SCOPE</td>
<td>On completion of this module the trainee will be able to work within a multiprofessional team to provide specialist advice and support with respect to dataflow and how this can be used in the healthcare setting to assure quality, safe healthcare services. They will be skilled in critical analysis of data used for a range of activities, including funding and coding.</td>
<td></td>
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</tr>
</tbody>
</table>

**LEARNING OUTCOMES**

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

1. Examine a work based related dataflow and review how data are collected, analysed and used to support care, research and healthcare management within the organisation, including a healthcare science service.
2. Examine how large NHS data sets are created and used to support research and critical evaluation of practice, make funding decisions, and contribute to the formulation and delivery of plans and strategies for meeting health and social care needs.
3. Analyse the strengths and weaknesses, from a data perspective, of activity-based funding mechanisms.
4. Assess the strengths and weaknesses of SNOMED CT, ICD 10 and OPCS5, and present the analysis and the finding in a written report.
5. Review the challenges involved in coding clinical encounters; assess what kind of granularity of coding is practical and present at a team or departmental meeting.
6. Represent a healthcare problem as a decision tree, including the views of patients where possible, and use the decision tree to inform the solution to the healthcare or healthcare science problem.
**CLINICAL EXPERIENTIAL LEARNING**

The clinical experiential learning for this module is:

- Visit different locations where NHS data sets are created and used to support research and make funding decisions, identifying the strengths and weaknesses of the data sets and discussing your findings with your supervisor.
- Observe the work of clinical coders and discuss the challenges faced by clinical coders and how solutions to the issues raised can be resolved.

**PROFESSIONAL PRACTICE**

Trainees should ensure they refer to the professional practice learning framework and continue to achieve the professional practice competences alongside the competences defined in this module.
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 1, 2, 3, 4, 5, 6      | Apply information governance principles and best practice in the workplace, including confidentiality. | • The legislation, regulatory guidance and NHS protocols regarding the security, confidentiality and appropriate sharing of patient identifiable information.  
• Role of the Caldicott Guardian.  
• The different arrangements and the associated responsibilities of clinical staff for security of all types of clinical information, especially electronically held, and for using such data for ‘secondary’ purposes. |
| 1                     | Examine a dataflow and review how data are collected, analysed and used to support care, research and health and care management within the organisation. | • Data flows in the NHS and social care and support landscapes.  
• Data and information (structured and unstructured) analysis methodologies and techniques.  
• National data sets and models.  
• Data collection methodologies.  
• Data reporting and presentation tools and techniques.  
• Quantitative outcomes measures and their application.  
• Management information systems.  
• Safety and security.  
• Links between data, information and insights. |
| 1                     | Present your findings in a written report and verbally to your line manager and peers. | • Critical appraisal techniques.  
• Knowledge representation.  
• Data visualisation techniques.  
• Predictive modelling techniques.  
• Knowledge management techniques and approaches. |
| 2                     | Critically evaluate how large NHS data sets are created and used to support research and make funding decisions. | • Data mining techniques.  
• Data warehousing.  
• Transparency: challenges and solutions.  
• Secondary uses of data.  
• Role of national data collection and analysis services. |
<p>| 2                     | Work with a clinical team and discuss the perceived strengths and | |</p>
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
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</table>
| 2                     | Critically evaluate how data are used to support research and critical evaluation of practice. | - Application of data in national commissioning strategy and planning.  
- Transparency – challenges.  
- Information governance and ethical considerations. |
| 2                     | Present your findings in a written report and verbally to your line manager and peers. | - Presentation options for different audiences.  
- The characteristics of effective and high-quality health initiatives from a patient perspective. |
| 3                     | Analyse the strengths and weaknesses, from a data perspective, of activity-based funding mechanisms. | - Uses of data in activity-based funding.  
- Alternatives to activity-based funding.  
- Examples of activity-based approaches.  
- Pros and cons of activity-based mechanisms. |
| 3                     | Propose changes to the use of data in activity-based funding mechanisms within your local health environment. | - The nature and purpose of different coding and classification systems in health.  
- Uses of coding and classifications systems.  
- Pros and cons of each. |
| 4                     | Assess the relative strengths and weaknesses of SNOMED CT, ICD 10 and OPCS5. | - Data analysis techniques.  
- Presentation options for different audiences. |
| 4                     | Present the analysis and the finding in a written report, making judgements in relation to the strength of the evidence. | - Coding and data quality issues.  
- Different approaches to coding practice.  
- The role of clinicians in coding and classification.  
- Uses of coded data. |
| 5                     | Review the challenges involved in coding clinical encounters and include an assessment of the kind of granularity provided by each coding system. | - Coding and data quality issues.  
- Different approaches to coding practice.  
- The role of clinicians in coding and classification.  
- Uses of coded data. |
<table>
<thead>
<tr>
<th>KEY LEARNING OUTCOMES</th>
<th>COMPETENCES</th>
<th>KNOWLEDGE AND UNDERSTANDING</th>
</tr>
</thead>
</table>
| 5                     | Write a short report summarising your findings and present the key messages at a team or departmental meeting. | • Report writing.  
                          • Presentation techniques.  
                          • How to respond to questions. |
| 6                     | Represent a healthcare problem as a decision tree. | • Decision support methodologies and their application.  
                          • Nature of decision trees.  
                          • Knowledge representation theory and practice.  
                          • Application of mathematical approaches to machine learning. |
| 6                     | Use the decision tree to develop new guidelines to solve the healthcare problem. | • Structure and content of clinical guidelines.  
                          • Uses of decision trees in health and care. |
SECTION 9: APPENDICES
Appendix 1: Contributors

Members of the STP MSc and Work Based Programme in Clinical Bioinformatics

Development of the STP Programme (MSc Clinical Sciences and Work Based programme) for Clinical Bioinformatics has been coordinated by the Modernising Scientific Careers team and the National School of Healthcare Science working with NHS, Public Health England and Higher Education colleagues. The professionals who have contributed to the development of this Scientist Training Programme since 2012 include:

Jennie Bell           Birmingham Women’s Hospital
Sanjeev Bhaskar       Central Manchester Foundation Trust, St Mary’s Hospital
Chris Boustred        NE Thames Regional Genetics Department, London
Andy Brass            The University of Manchester
Rachel Butler         All Wales Medical Genetics Service, Cardiff
Tim Dallman           Public Health England
Angela Davies         The Nowgen Centre, Manchester
Val Davison           National School of Healthcare Science, Birmingham
Wendy Dearing         NHS Wales Informatics Service, Cardiff
Andrew Devereau       St Mary’s Hospital, Manchester
Rob Elles             St Mary’s Hospital, Manchester
Mike Elmore           Public Health England
Anthony Fisher        Royal Liverpool University Hospital
Michael Gandy         University College London
Paul Ganney           University College London Hospitals
Chris Gibson          National School for Healthcare Science, Birmingham
Rifat Hamoudi         University College London
Claire Hardiman       Institute of Physics & Engineering in Medicine, York
Henry Kent            University College London
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Dominic McMullan      West Midlands Regional Genetic Laboratory, Birmingham
Di Millen             NHS England, Leeds
Raju Misra            Public Health England
Georgina Moulton      The University of Manchester
Richard Myers         Public Health England
Robert Newton         NHS National Genetics Education and Development Centre, Birmingham
Tony Paget            University of Swansea and UKCHIP
Mike Part             NHS Commissioning Board, London
Steven Platt          Public Health England
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Anneke Seller        Oxford Regional Genetics Service, Churchill Hospital
Lee Silcock           West Midlands Regional Genetic Laboratory, Birmingham
Andy Simmons          King’s College London
Mike Sinclair         Dorset County Hospital NHS Foundation Trust, Dorchester
Jackie Smith          Health and Social Care Information Centre, Leeds
Comments that helped shape rotations B and C were received from:

- Martin Graves, Cambridge University Hospitals NHS Foundation Trust
- Andrew Hoole, Cambridge University Hospitals NHS Foundation Trust
- Peter Jarritt, Cambridge University Hospitals NHS Foundation Trust

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

- IPEM, Institute of Physics and Engineering in Medicine
- Modernising Scientific Careers Professional Advisors: Dr Graham Beastall, Dr Derek Pearson
- National School of Healthcare Science Professional Leads: Theresa Fail, Dr Chris Gibson
- Contributing Professional Bodies: Association for Clinical Genetic Science (ACGS)
Appendix 1: Programme Amendments

This section lists the programme amendments following first publication.

Amendments March 2014

These amendments apply to trainees commencing STP in the academic year 2015/15.

1. Specialist modules for Clinical Bioinformatics (Physical Sciences) have been added.
2. Specialist modules for Clinical Bioinformatics (Health Informatics Science) have been added.

The new version is called STP MSc Clinical Bioinformatics version 2.0 for 2014-15
For any queries regarding this change please email msc.hee@nhs.net

Amendments September 2015

A summary of the learning outcomes that have been modified to explicitly describe their applicability to public health are shown below. The Academic Provider has been involved in these discussions as well as lead authors of rotational modules.

Division: Cross-Divisional
Theme: Clinical Bioinformatics
Rotation A: Introduction to Clinical Bioinformatics and Genetics [10 credits]

MSc Learning Outcome

1. Discuss the governance and ethical frameworks in place within the NHS and across the public health function [including, where relevant, the civil service] and how they apply to bioinformatics.
12. Discover resources linking polymorphism to disease processes and antimicrobial drug resistance.

Work-Based Learning Outcome
2. Perform sequence alignment tasks followed by clustering and phylogeny.
4. Compare major bioinformatics resources for clinical diagnostics or pathogen typing and identification, and how their results can be summarised and integrated with other lines of evidence to produce clinically valid reports.

Division: Cross-Divisional
Theme: Clinical Bioinformatics
Rotation B: Computing for Clinical Scientists [10 credits]

MSc Learning Outcome

10. Give examples of software allowing databases to communicate with web browsers, e.g. Simple Object Access Protocol (SOAP), Common Gateway Interface (CGI) and Representational State Transfer (REST).
11. Discuss security issues around client server systems and system security in the context of the NHS and public health systems [including, where relevant, the civil service], data governance and ethics concerns.

**Division:** Cross-Divisional  
**Theme:** Clinical Bioinformatics  
**Rotation C:** Information and communications Technology in the Clinical Environment [10 credits]

**MSc Learning Outcome**

1. Discuss the basis of data capture, measurement, presentation from clinical and laboratory equipment.  
2. Discuss the usage of clinical data generated by a device.

**Division:** Cross-Divisional  
**Theme:** Clinical Bioinformatics  
**Specialism:** Genomics  
**Year 2:** Advanced Clinical Bioinformatics [10 credits]

**Amendment to stem:**

On successful completion of this module the trainee will, in the context of both human and microbes:

**Work-Based Learning**

1. Identify a clinical and/or laboratory bioinformatics requirement and develop, validate and deploy a bespoke workflow for clinical or public health analysis.

The new version is called STP MSc Clinical Bioinformatics version 1.0 for 2017-18
## Appendix 3: Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</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 and skills required to undertake work activities within a local context. This differs from a role – see below.</td>
</tr>
<tr>
<td>Key learning outcome</td>
<td>A defined learning outcome linked to relevant competence(s) within the workplace Learning Guide.</td>
</tr>
<tr>
<td>Knowledge and understanding</td>
<td>The knowledge and understanding that must be applied in the workplace to achieve the stated competence.</td>
</tr>
<tr>
<td>Learning framework</td>
<td>The specification for work based learning contained within the Learning Guide.</td>
</tr>
<tr>
<td>Learning module</td>
<td>A distinct set of learning outcomes and competences that form part of a programme. Modules may be rotational, specialist,</td>
</tr>
<tr>
<td><strong>Learning outcome</strong></td>
<td>A high-level, outcome-based statement that describes what a trainee will be able to do at the end of the module.</td>
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</tr>
<tr>
<td><strong>Mentoring</strong></td>
<td>Mentoring is a process in which a trainer (mentor) is responsible for overseeing the career and development of the trainee. The emphasis is therefore on the relationship (rather than the activity).</td>
</tr>
<tr>
<td><strong>Module aim</strong></td>
<td>The overall objective of a work based learning module – defining the intended learning achievements of the trainee. The aim works together with the ‘Scope’ statement to define the overall objectives and scope of the module.</td>
</tr>
<tr>
<td><strong>Module scope</strong></td>
<td>A statement within work based learning modules that defines the range/limits of the learning undertaken by the trainee in a module – patients/investigations/equipment/modalities, etc.</td>
</tr>
<tr>
<td><strong>National Occupational Standards</strong></td>
<td>Nationally recognised standards of expected workplace performance and level of competence for a role. The standards are outcome based, defining what the role holder should to be able to do, as well as what they must know and understand to demonstrate competent work performance. National Occupational Standards are supported by nationally agreed frameworks of expected attitudes, behaviour and skills.</td>
</tr>
<tr>
<td><strong>Practical skill</strong></td>
<td>A cognitive, psychomotor, physical, or communicative ability that supports performance of the required role.</td>
</tr>
<tr>
<td><strong>Programme</strong></td>
<td>The package of learning, teaching assessment and quality assurance leading to an award.</td>
</tr>
<tr>
<td><strong>Provider</strong></td>
<td>An organisation that delivers required training and learning activities to specified quality assurance requirements.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>A collection of functions undertaken in the workplace that represent the main broad areas of work for all similar workers at national level. A role differs from a job, the latter being defined specifically for a local context.</td>
</tr>
<tr>
<td><strong>Specialism</strong></td>
<td>A focused area of practice within a theme of healthcare science.</td>
</tr>
<tr>
<td><strong>Trainer</strong></td>
<td>A qualified individual who provides learning and development support for trainees.</td>
</tr>
<tr>
<td><strong>Theme</strong></td>
<td>A cluster of related specialisms within a division of healthcare science.</td>
</tr>
<tr>
<td><strong>Work based learning</strong></td>
<td>Learning that takes place in a real work setting and involves the application of academic learning to real work activities.</td>
</tr>
<tr>
<td><strong>Work performance</strong></td>
<td>The requirements of satisfactory and consistent demonstration of competence in specified functions for a work role.</td>
</tr>
<tr>
<td><strong>Workplace</strong></td>
<td>A real work setting in which the trainee can apply learning.</td>
</tr>
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</table>
Appendix 4: 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 practise 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 wellbeing

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

1.2 **Probity**

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

1.2.2 Inform the appropriate regulatory body without delay if, at any time, you have accepted a caution, been charged with or found guilty of a criminal offence, or if any finding has been made against you as a result of fitness to practise 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 multidisciplinary 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 the appropriate level of skill in the use of information and communications technology

2.3 Quality

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

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

3.1 **Clinical Practice**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Domain 4: Research, Development and Innovation**

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

4.1 **Research, Development and Innovation**

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

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

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

4.1.4 Manage research and development within a governance framework

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

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

4.1.7 Interpret data in the prevailing clinical context

4.1.8 Perform experimental work, produce and present results

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

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

**Domain 5: Clinical Leadership**

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

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

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Appendix 5: Further Information

NHS Networks
An open network to share curricula produced for the Modernising Scientific Careers programme. Join this network to get updates whenever there is new content. www.networks.nhs.uk/nhs-networks/msc-framework-curricula/

Details of the Scientist Training Programme, including MSc Clinical Science Curricula, Work Based Learning Guides. www.networks.nhs.uk/nhs-networks/msc-framework-curricula/stp

Council of Healthcare Science in Higher Education (CHS)
The Council of Healthcare Science in Higher Education builds a unified identity of academic healthcare science by representing the interests of the sector. Working to improve and maintain quality in healthcare science education and training, the Council itself is made up of senior members of the academic healthcare science team. The work of the Council is also informed by two special interest groups made up of staff involved in the delivery and implementation of the Modernising Scientific Careers programme. The Scientist Training Programme Special Interest Group brings together the providers of the MSc-level programme. www.councilofhealthcarescience.ac.uk/

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

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

Health and Care Professions Council (HCPC)
The HCPC is a regulator set up to protect the public. It keeps a register of health professionals who meet the HCPC standards for their training, professional skills, behaviour and health. www.hpc-uk.org/