



The Royal College of Pathologists
Pathology: the science behind the cure

Clinical Biochemistry

2015–2016



HSST Curriculum for Clinical Scientists
incorporating FRCPATH

Index

FRCPath Curriculum for Clinical Scientists in Clinical Biochemistry (Higher Specialist Scientific Training)

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FRCPath Curriculum for Clinical Scientists in Clinical Biochemistry (Higher Specialist Scientific Training)

1.1 The Role of the Consultant Clinical Scientist in Clinical Biochemistry

Context

Clinical biochemists work in laboratories and help to diagnose and manage disease through the analysis of blood, urine and other body fluids. They produce and validate the results of chemical and biochemical analyses and advise clinicians and GPs on the appropriate use of tests, the interpretation of results, and the follow up investigations that may be required.

Clinical scientists in clinical biochemistry deliver a timely, caring and effective clinical service to patients. Through a programme of Higher Specialist Scientific Training (HSST) reflecting the standards of training undertaken by doctors to train as consultants, selected clinical scientists will bring high-level scientific and clinical leadership as Consultant Clinical Scientists. In conjunction with medical colleagues and with other professionals, they will challenge the evidence of existing practice; innovate and introduce new investigations, treatments and devices; and build the evidence for change through ethical and appropriate clinical research to influence practice in the workplace and nationally.

Scientific Services and Clinical Care

Consultant Clinical Scientists in clinical biochemistry are the national experts in their clinical scientific service. While their clinical scientist colleagues deliver today's services, Consultant Clinical Scientists prepare for tomorrow. Whilst Healthcare Science Practitioners and Clinical Scientists are trained to follow current guidelines, Consultant Clinical Scientists will be developing the evidence for new ones and contributing strategically to the national development of clinical biochemistry.

They will make continuous critical appraisal of the scientific literature, and contribute to it; they will constantly question the evidence for practice with a sharp focus on patient outcomes, ensuring that investigations and rehabilitation are appropriate, timely and delivered with the needs of patients at the forefront. They will be responsible for ensuring that cutting edge science is introduced into clinical biochemistry scientific practice, and leading developments in a wide range of areas of practice. Throughout, they will be committed to, and experienced in multi-disciplinary team working at the highest level; the various roles within the multi-professional team should collaborate synergistically in a complementary way, based on agreed care pathways that clarify the respective roles of both Clinical Scientists and medical colleagues.

Leadership and Management

Consultant Clinical Scientist in clinical biochemistry will need to bring strong leadership to their own services and the profession - requiring skills above and beyond simply management. They will give their department's strategic direction, ensuring that this is compatible with the overall direction of the organisation; they will have both the knowledge and authority to develop their service, using vision and their scientific knowledge and expertise to ensure that the potential and rationale for new developments are understood. They will be accountable for service quality, developments and clinical governance, and practised in influencing other colleagues so that excellent science remains at the forefront of clinical practice. In addition they will have a key role in promoting and ensuring quality and consistency of standards across services by promoting networks for quality assurance locally and nationally.

Research, Development, Innovation and Education

Consultant Clinical Scientists in clinical biochemistry will be clinical scientific leaders and will have the underpinning basic science and research skills to question their own clinical practice, as well as the breadth of cross-disciplinary technical skills to innovate and to effect change. They will be able to evaluate critically the benefits and opportunities offered by new scientific discoveries and technological advances, contextualising them to the clinical arena and the skills to influence their implementation into service for the benefit of patients. Critically, they will have learnt and practised the skills needed to teach the next generation of clinical scientists

how to approach learning about science in health in order to optimise outcomes for patients. Consultant Clinical Scientists in clinical biochemistry will make continuing distinguished contributions to the furtherance of the science and of practice of the specialism, and should be established and known nationally for their contribution, publications and leadership in the profession.

1.2 Overall Description of the HSST Programme

Modernising Scientific Careers (MSC) is a UK programme led by the Chief Scientific Officer (CSO), working in conjunction with the other devolved health administrations and relevant scientific, medical and surgical educational institutions. MSC provides a transparent, standards-driven educational and training framework for more than 45 specialisms in healthcare science.

Higher Specialist Scientist Training (HSST) is a five-year training programme that has been developed to enable a selected cohort of Clinical Scientists to be trained to take on the role of a Consultant Clinical Scientist. During training, Clinical Scientists in HSST and their supervisors will use this HSST curriculum to advance their learning, practice and performance, and monitor their progress by reference to the learning outcomes and competences defined within it. Clinical Scientists in HSST will be encouraged to lead their own learning and to measure their achievement against clear learning objectives. It will help the Clinical Scientist in HSST and their educational supervisor/mentor to maintain a regularly reviewed and updated education plan to ensure that all the outcomes of the curriculum are met. Finally, the curriculum will facilitate regular assessment of the Clinical Scientist's progress and satisfactory completion of training against high-quality standards, providing the means by which the public can be assured that individuals are fit for Consultant Clinical Scientist practice.

It is expected that Clinical Scientists in HSST will train in a multi-professional environment with the opportunity to learn and work with those in other training programmes across the health professions, e.g. medical, nursing, pharmacy and allied health professionals, and with those outwith health, for example those following MBA, leadership, management and finance programmes.

1.3 Curricula Development, Review, Updating and Implementation

HSST curricula were developed during 2012–2015 under the auspices of several of the Medical Royal Colleges (MRCs), following the publication in 2012 of a formal statement of support from the Academy of Medical Royal Colleges (AoMRC) [www.aomrc.org.uk/about-us/news/item/academy-statement.html]. Membership of the MRC curricula development groups included practising senior healthcare scientists nominated by scientific professional bodies and medical representatives from the MRCs, as well as educationalists from the relevant MRC and MSC teams. Consultant-level scientists from the specific scientific specialism provided the major expert input into the development of the scientific curriculum. The public, a range of scientific and medical professional bodies, universities, patients, employers and trainees were also involved. Specifically, review and comments on this curriculum were sought from other MRCs with an interest in the specialism, their related Specialty Advisory Committees (SACs) and specialist societies, healthcare science professional bodies, trainees in healthcare science, patients and the public. Governance and oversight of curricula development was through a dual process involving each relevant MRC and the Health Education England (HEE) educational approval process on behalf of the National Health Service (NHS) and HEE.

Although the curriculum content is derived from current UK clinical, diagnostic and laboratory practice in clinical science, there have been intensive efforts to identify and predict future technological developments, changes in service delivery and future patient requirements in order to ensure that the curricula are as robust and as sustainable as possible. This is in relation both to scientific content and anticipated future scientific developments (e.g. in genomics and precision/personalised medicine), and is reflective also of the new commissioning system for service and training. There will be regular reviews and updates of the curriculum to ensure that it remains relevant.

Standards of professionalism in healthcare science are set out in *Good Scientific Practice* (GSP; www.academyforhealthcarescience.co.uk/good-scientific-practice/), which describes the principles and values developed for the profession and which are comparable to the standards set by the General Medical Council (GMC) for medicine. This has been developed into a GSP syllabus that is common to all HSST curricula. The five domains of GSP emphasise clinical leadership development,

expert scientific and clinical practice, research and innovation, and excellent communication and team working behaviours. For the public, it describes more specifically what can be expected from those who will be CCSs responsible for patient care.

The Academy for Healthcare Science (AHCS) will assess applications from Clinical Scientists applying for recognition of previous training, experience and qualifications ('equivalence to HSST'), based on the professional and scientific contents and standards of behaviour set out in the curricula. Applicants seeking equivalence will be evaluated through AHCS processes against HSST curricula and will need to demonstrate that they have met AHCS requirements for the Certificate of Equivalence in a given area of practice. This will entitle the Clinical Scientist to register on the Higher Specialist Scientist (HSS) Register held by the AHCS.

Implementation of the curriculum will be evaluated and monitored by the National School of Healthcare Science (NSHCS) through continuous feedback from training programmes, educational supervisors, trainers, Clinical Scientists in HSST and patients.

1.4 Curriculum Purpose

The purpose of this HSST curriculum is to define and specify the training programme and outcomes of training to ensure that Clinical Scientists undertaking HSST are fully prepared to provide, lead and innovate scientific services at consultant level in the NHS and in the rest of the UK. It aims to promote excellence through training, assessment and professional development so that Clinical Scientists exiting HSST programmes are fit to practise as Consultant Clinical Scientists.

This HSST curriculum is modular in design. It builds on the Scientist Training Programme (STP) and leads to the Certificate of Completion of Higher Specialist Scientist Training (CCHSST) issued by the NSHCS. Clinical Scientists in HSST will require evidence of satisfactory achievement of the requirements of the GSP professional syllabus, the specialty-specific syllabus and the related assessment programme (including the Innovation in Clinical Sciences [ICS] project), which together form the curriculum for the attainment of the standards of professional and specialism-based knowledge applied to practical, laboratory, clinical, teaching, research activities, as well as innovation. In addition, for those in Physical Science, the Physiological Sciences and Clinical Bioinformatics, the CCHSST will also indicate that the underpinning doctoral programme/award (DClinSci) has been achieved. In the Life Sciences, the CCHSST indicates achievement of the FRCPath and the ICS project (which together meet the learning outcomes of the doctoral programme), although the doctoral award itself is not required. The CCHSST will enable the AHCS to admit the Clinical Scientist to its HSS Register. Once admitted to this Register, Clinical Scientists will be eligible to apply for available Consultant Clinical Scientist posts.

This curriculum also describes the integral teaching, learning programme and assessment programme that are consistent with the both the Health and Care Professions Council's (HCPC) and the GMC's Standards for Curricula and Assessment Systems (April 2010).

1.5 Entry Requirements

Once the Local Education and Training Board (LETB) [or equivalent bodies in the rest of the UK] and training provider (which has been accredited by the NSHCS accreditation process) have agreed the establishment of an HSST post, entry into HSST programmes will be through a national competitive appointment and benchmarking process in England, led by the NSHCS.

Eligibility for appointment into an HSST programme requires the following:

- registration (or eligibility and application to register) as a Clinical Scientist with the HCPC;
- *normally* at least one further year in the workplace to consolidate and enhance skills, learning and experience (including research and education);
- where required, applicants must be eligible to register for doctoral-level study at a higher education institution (HEI);

- individual specialisms may also have specialty-specific requirements, which will be clarified at the time of the appointment process for the HSST post through the job description and person specification.

An individual appointed to an HSST programme may not commence the programme until registration with the HCPC has been completed.

1.6 Routes of Entry

There will be two routes of entry into HSST training. Through the direct entry route, the Clinical Scientist in HSST will be competitively appointed into a formal HSST post, established for the purpose of training a Consultant Clinical Scientist. Alternatively, some Clinical Scientists may enter into HSST with the support of their employers through an in-service training route that does not involve the creation of a new training post *per se*, although the potential appointee will have to meet benchmarking standards for entry into HSST. In both circumstances in England, a training grant will be allocated from the LETB to the provider training unit to support training.

All HSST applicants must participate and be successful in the national appointment process. For direct entry Clinical Scientists this is a competitive process with other applicants for the available training opportunity; for in-service Clinical Scientists, participating in the national selection process ensures benchmarking against the standards for entry into HSST for this specialism. The appointment process will select not only for scientific expertise and talent in all its manifestations, but for abilities in a range of professional areas, including leadership, innovation, personal skills and values.

1.7 Equality and Diversity

The AHCS, HEE, MSC, MRCs and scientific professional bodies are committed to the principle of diversity and equality in employment, membership, academic activities, assessment, examinations and training.

As part of this ethos these groups are committed to inspire and support all those who work, train and provide training in healthcare science to operate in a fair, open and honest manner. The approach taken is a comprehensive one and reflects all areas of diversity, recognising the value of each individual. This means that no one is treated less favourably than another on the grounds of ethnic origin, nationality, age, disability, gender, sexual orientation, race, or religion, in accordance with the Equality Act 2010. This reflects not only the letter but also the spirit of equality legislation, taking into account current equality legislation and good practice.

1.8 The HSST Curriculum

This curriculum sets out the standards of specialism-based knowledge, clinical judgement, technical and professional skills, attitudes and behaviour that must be acquired in order to practise and progress throughout the five-year training programme. The curriculum comprises the following components:

The ***Specialist Scientific Clinical*** syllabus, providing for:

- a broad understanding of the diagnosis and management of patients within the specialism from a clinical and scientific perspective;
- the diagnostic techniques required in the practice of the specialism;
- understanding of the clinical areas detailed in the curriculum;
- knowledge of the specialist areas defined within the curriculum.

The professional generic ***Good Scientific Practice*** (GSP) syllabus, setting out the requirement for the:

- communication skills required for practice in the specialism and the teaching, learning and assessment skills necessary for effective practice;

- acquisition of clinical leadership and management skills needed for the excellent delivery and development of clinical biochemistry scientific services;
- experience of research, development and innovation projects, and critical evaluation of published work in order to lead scientific, technological and service innovation;
- need for a life-long commitment to adopting a structured approach to continuing personal and professional development (CPPD);
- experience of the practice of clinical governance¹ and quality improvement activity, including audit (specialist and multidisciplinary) through evaluation of practice against the standards of evidence-based medicine;
- consistent demonstration and practice of attitudes, values and behaviours that support those set out in the NHS Constitution.

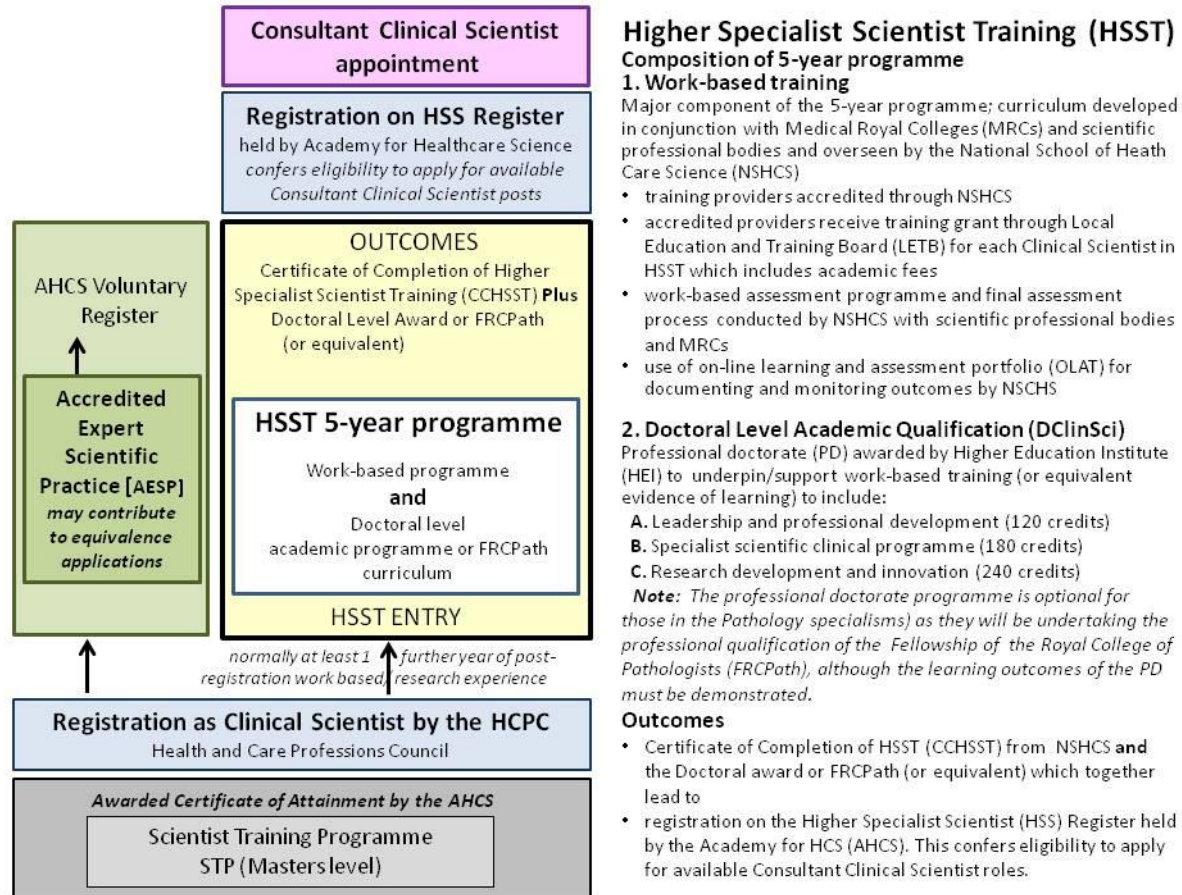
The Relationship of the GSP Syllabus to the Specialist Scientific Clinical Syllabus

The professional knowledge, skills and behaviour of *GSP* are contextualised and evidenced through clinical practice. It is not possible to achieve competence in the specialist scientific and clinical syllabus *unless* these professional skills and behaviours are also evident. Clinical Scientists in HSST must be able to show progress in acquiring GSP competences and the underpinning academic knowledge, demonstrating these behaviours across a range of situations as detailed in the scientific clinical syllabus.

1.9 The Structure and Operation of the HSST Training Programme

The broad structure and description of the HSST programme is shown overleaf.

¹ *A framework through which NHS organisations are accountable for continuously improving the quality of their services and safeguarding high standards of care, by creating an environment in which excellence in clinical care will flourish. Schellekens W. Clinical governance in a changing NHS. International Journal of Integrated Care, vol 6, April to June 2006.*



The implementation and quality management of the HSST programme is the responsibility of the NSHCS, which will ensure through its Themed Boards that Clinical Scientists in HSST are provided with access to an appropriate range of educational experience to complete their training. The appropriate Themed Board in the NSHCS will also monitor and support the overall progress of Clinical Scientists in HSST on a regular basis, throughout the entirety of the programme.

1.10 Modularity of Training and Learning

This curriculum has been developed in a modular format, with each module having defined competences, assessment requirements and learning outcomes. There is a staged approach requiring the satisfactory completion of specified modules within each stage prior to progression to the next, so that Clinical Scientists in HSST may not progress to Stage 2 of training until they have satisfactorily completed Stage 1. They will continue to broaden their experience and understanding of common clinical and scientific problems and their management throughout their training. The underpinning doctoral-level programme will provide the underpinning

academic framework for learning to support workplace practice. The knowledge gained and applied will be supported and assessed on an ongoing basis through quality assured workplace-based assessments and through a structured final assessment programme.

1.11 Doctoral-level Programme

A doctoral-level academic programme underpins HSST. The purpose of this doctoral-level programme is to formalise and *facilitate the learning* of Clinical Scientists in HSST as they:

- systematically acquire and apply a substantial body of scientific and clinical knowledge at the forefront of their specialism and embrace the future scientific and technology advances within the field;
- create and interpret new knowledge through original research and scholarship requiring advanced academic enquiry;
- systematically acquire, develop and apply the qualities and transferable skills necessary for employment as a Consultant Clinical Scientist, requiring the exercise of personal responsibility and taking largely autonomous initiative in complex and unpredictable situations;
- develop the knowledge, skills, experience, behaviours and attitudes required of a clinical leader in an evolving and rapidly developing health and life sciences sector.

Following a full tender and contracting process the doctoral programme will be provided by the Manchester Academy for Healthcare Science Education (MAHSE), a consortium of universities that will deliver the programme through partnership arrangements involving a range of organisations, including specialist professional bodies and/or MRCs. The doctoral programme will have three sections, reflecting the higher-level skills and requirements to support consultant-level practice:

- **Section A: Leadership and Professional Development** aligned to GSP, including leadership, professionalism, innovation, bio enterprise, teaching and learning, quality improvement, bioinformatics, health policy, human resource and business management, and research methods, although these areas are not necessarily exhaustive and others may be identified.
- **Section B: Specialist Scientific Clinical Programme** developed by the MRCs-led curriculum working groups of senior scientists and medical consultants, underpinned by supervised work-based and mentored training. This section will centre on the knowledge and understanding learning outcomes from the specialist scientific clinical syllabus for each HSST specialism, underpinned by supervised work-based and mentored training, reflective practice, experiential learning and a robust assessment system.
- **Section C: Research, Development and Innovation** that aims to improve health and health outcomes and may include scientific and/or clinical outcomes, service transformation, innovation, leadership, policy, education, or educational research.

Since a key purpose of the doctoral programme is to facilitate the opportunities for learning by Clinical Scientists in HSST by providing a structure within which they can obtain underpinning knowledge and learning to support their progression through the programme, it is not necessarily a requirement for the doctoral award itself to be obtained. The doctoral-level programme will be designed in a modular format, and although successful completion of the totality of the programme will lead to the award of a professional doctorate, it is not an essential requirement for all of those undertaking HSST programmes to obtain the doctoral award *per se*.

In the Life Sciences, for example, Clinical Scientists in HSST must obtain the FRCPATH, which includes the learning outcomes of the professional doctorate, but not necessarily obtain the award itself. In the Physiological Sciences, Medical Physics and Biomedical Engineering, and Clinical Bioinformatics, all Clinical Scientists in HSST will be expected to participate in the full professional doctorate programme (or potentially show equivalence to aspects of it) and gain the professional doctorate award. It will therefore be necessary for all Clinical Scientists in HSST to demonstrate that they have acquired the knowledge, skills and outcomes of the HSST curriculum to the required doctoral level in all the practice and academic elements of the programme. The doctoral-level award and programme will underpin and support this, but in itself is not an end point of the HSST programme; nor is the award required for the demonstration of competence and fitness to practise. This will be defined within the HSST assessment strategy and in conjunction with the MRCs and the NSHCS.

Research

Clinical Scientists in all HSST programmes will also be expected to undertake doctoral-level research, usually through the commissioned professional doctorate. Alternatively, research that demonstrates that such a level has been achieved may be offered, e.g. a coherent body of papers that reaches the standard suitable for publication in peer-reviewed journals, which has been undertaken during the HSST programme or during the three years before entry to the HSST programme. Clinical Scientists in HSST will also be encouraged to present and defend their research at national/international scientific conferences.

1.12 Models of Learning

HSST curricula will be delivered through work-based experiential learning and through achievement of the underpinning academic programme and/or its learning outcomes. The environment within the departments must therefore encourage independent self-directed learning and make opportunities for relevant off-the-job education by making provision for attendance at local, national and, where appropriate, international meetings and courses. It is the Clinical Scientist's responsibility, with the support of their educational supervisor and trainers, to seek learning and training opportunities and ensure that they access appropriate experiential learning. The training programme must allow for a significant component of clinical training and experience through service provision. This will normally be in the range of 30–80% of training time, depending on the specialism and the year of training.

It is therefore recognised that a large component of training will occur using an apprenticeship model of learning, under appropriate work-based supervision. Delivery of training must be under the supervision of a scientific or medical consultant and provide appropriate experiential content, including a broad exposure to both scientific and clinical issues. The environment within the department should encourage independent self-directed learning. The NSHCS will be responsible for the quality assurance of the work-based learning environment.

1.13 Learning Experiences

A wide range of teaching/learning opportunities/methods will be used during the programme to support the attainment of the learning outcomes and competences. However, it is part of the Clinical Scientist's professional development to seek out and organise relevant learning opportunities for themselves. In consultation with their educational supervisor, the Clinical Scientist in HSST may wish to consider organising some of the following learning events.

Experiential or opportunistic learning (learning through normal routine work experiences, learning by doing, observing, critical reflection), which will include:

- experiential working in the specialism, gaining practical and clinical skills, and observing, assisting and discussing aspects of practice with senior/consultant scientific and medical staff, patients and other members of the multi-professional team;
- task-specific, on-the-job training, working under consultant supervision and reflecting on and discussing experiences;
- observation of diagnostic/clinical/laboratory methods;
- tailored clinical experience, including team and directorate meetings in the speciality;
- attendance and participation at relevant organisational committees to enhance management and leadership skills;
- attending and participating in training provided through equipment and kit manufacturers;
- attending and participating in MDT meetings;
- teaching undergraduates and other health professionals;
- attending and participating in regional, national and international medical or scientific conferences;
- interaction with/attachment to specialist reference laboratories where required;
- completion of a doctoral-level research or innovation project from identification of the research question to dissemination of the output;
- contribution, as the leader or member of a team, to grant applications;
- dissemination of research findings through publications, presentations, etc.;
- attending and participating in medical clinics, including speciality clinics;

- gaining practical diagnostic experience;
- attending and participating in formal postgraduate education/teaching.

Learning approaches, which may include:

- independent self-directed learning;
- e-learning and m-learning (mobile learning);
- learning with peers;
- clinical skills teaching, including simulation;
- advanced library study, journal review;
- work-based experiential learning;
- small group teaching, lectures, tutorials;
- advanced journal clubs, audit meetings, etc.;
- service development projects.

1.14 Completion of Training

Successful completion of the HSST programme results in the award of a CCHSST by the NSHCS. The award will be made to Clinical Scientists in the Physical Sciences and Biomedical Engineering, the Physiological Sciences and Clinical Bioinformatics who complete the requirements of the work-based curriculum through work-based training, the ICS project and the professional doctorate, and who participate in the full training period (or as much as may be required if assessed by the AHCS as having done an equivalent period of training at some other point), including the final annual progression review/assessment, denoting satisfactory completion of the programme. In the Life Sciences, the CCHSST indicates achievement of the FRCPATH and the ICS project (which together meet the academic learning outcomes of the doctoral programme), although the doctoral-level award itself is not required. Clinical Scientists in HSST in the Life Sciences may, however, choose to undertake modules from the professional doctoral programme or, indeed, undertake the entire doctoral-level programme and achieve the DClinSci award.

The CCHSST indicates that the Clinical Scientist has achieved the standards set by the AHCS in order to gain entry to their HSS Register, having demonstrated the ability to lead, manage and critically evaluate services and practice, contributing to the team and individually to scientific, technological and service innovation. A Clinical Scientist on the HSS Register will be expected to maintain their professional development in line with GSP. It is anticipated that in due course, as for medical and surgical consultants, Consultant Clinical Scientists will undergo a regular process of revalidation that will be developed and overseen by the AHCS.

1.15 Supervisory Arrangements

Supervision and Feedback

Supervision, support and mentoring for Clinical Scientists in HSST must be available to ensure safe and effective practice for patients and the public, and to support independent learning and high standards of professional conduct. Those undertaking a supervisory, training or mentoring role for Clinical Scientists in HSST programmes must have relevant professional qualifications and experience and have undertaken appropriate and up-to-date training as agreed by the NSHCS. The HEI providing the underpinning doctoral programme will also be expected to have an academic supervisory, support and mentoring scheme in place to support the academic programme.

Clinical Scientists in HSST must be appropriately mentored, supported and supervised by the senior scientific and medical staff on a day-to-day basis, under the direction of a designated educational supervisor. Educational supervision is a fundamental conduit for delivering teaching and training in the NHS. It takes advantage of the experience, knowledge and skills of educational supervisors/trainers and their familiarity with clinical and scientific situations. It ensures regular interactions between an experienced clinician and the Clinical Scientist in a HSST programme. This is the desired link between the past and the future of scientific practice, to

guide and steer the learning process of the Clinical Scientist in the programme. Clinical supervision is also vital to ensure patient safety through providing Clinical Scientists in HSST with the support to deliver high-quality services to patients. It is therefore expected that Clinical Scientists in HSST programmes reaching the end of their training will also be able to demonstrate competence in clinical supervision before the award of the CCHSST.

Educational supervision should promote independent learning and reflective practice and support the Clinical Scientist in HSST to produce action plans to address identified learning needs. It will need to ensure that the Clinical Scientist learns specific higher skills and competences, 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 also require the provision of pastoral care for some Clinical Scientists in HSST. Supervision during training will be undertaken by a range of appropriately trained healthcare professionals within and outwith healthcare science, e.g. consultant or senior medical staff, Clinical Scientists, research scientists, senior biomedical scientists, etc.

The Educational Supervisor

The educational supervisor will be an appropriately skilled senior scientist/clinician under whose direct supervision the Clinical Scientist in HSST is working. This person(s) will be responsible for monitoring, supporting and assessing the Clinical Scientist on a day-to-day basis in their scientific, clinical and professional work, and would usually be expected to take on the role of co-supervisor of the research project as part of the academic supervisory team.

To become an educational supervisor, a senior scientist or medical consultant must have consistently demonstrated an interest in and a commitment to teaching, learning, assessment and training, have appropriate access to teaching resources and be trained in the appropriate delivery of workplace-based assessments and learner-centred feedback in accordance with the MSC HSST assessment strategy. Educational supervisors must undertake appropriate training in educational principles and assessment (e.g. Training the Trainers programme, offered by the NSHCS in England or MRCs). Attainment of formal qualifications such as a postgraduate award in teaching, learning and assessment or an MSc in Medical/Clinical Education is desirable for some members of each supervisory team. Educational supervisors are expected to keep up to date with developments in training, have access to the support and advice of their senior colleagues regarding any issues related to teaching and training, and to keep up to date with their own professional development.

The role of the HSST educational supervisor therefore, with respect to the Clinical Scientist in HSST, includes responsibilities to:

- have overall educational and supervisory responsibility for the Clinical Scientist in HSST in a given post;
- ensure that they are familiar with the curriculum for each year/stage of training;
- ensure that they have appropriate day-to-day supervision appropriate to their stage of training;
- act as a mentor and help with both professional and personal development;
- ensure that they are making the necessary clinical and educational progress;
- ensure that they are aware of the assessment system and process;
- agree a training plan (formal educational contract) to make clear the commitment required to ensure that appropriate training opportunities are available;
- ensure that an induction (where appropriate) has been carried out soon after appointment to the HSST programme;
- discuss the training requirements and progress with other trainers with whom the Clinical Scientist in HSST spends a period of training;
- undertake regular formative/supportive appraisals (at least two per year, approximately every six months) and ensure that both parties agree to the outcome of these sessions and a written record is kept;
- regularly review the evidence submitted to the Online Learning and Assessment Tool (OLAT) so that they are aware of their progress and are encouraged to discuss any issues arising during training, ensuring that records of such discussions are kept;
- keep the NSHCS Professional Lead informed of any educational or pastoral issues that may affect the Clinical Scientist's ability to complete the HSST programme.

The process of gaining competence in supervision must start at an early stage in training, with the Clinical Scientist in HSST supervising more junior trainees, e.g. those undertaking STP. The example provided by the educational supervisor is the most powerful influence on the standards of conduct and practice of a Clinical Scientist in HSST.

Supporting Roles

In addition to the educational supervisor who will have overall educational responsibility for the Clinical Scientist in HSST, there will be other clinical trainers and assessors who will help facilitate the provision of educational opportunities and feedback to the Clinical Scientist as required. They will also be in a position to provide evidence to support the educational supervisor's judgement about a Clinical Scientist's overall performance, competence and capability. Since Clinical Scientists in HSST will learn in a multi-professional environment, assessments will be carried out by a range of members of the team, including those who may not be scientifically or medically qualified. However, all those carrying out assessments must be appropriately qualified in the relevant professional specialism and trained in the methodology of workplace-based assessment, including the delivery of appropriate feedback. This does not apply to multisource feedback (MSF), where those contributing to the feedback will be from a wider pool. Clinical Scientists in HSST and their educational supervisors should look to identify opportunities to incorporate feedback from patients, where possible, in the assessment of competence.

1.16 The Assessment Programme

The assessment programme for HSST is set within the context of the overall assessment strategy for MSC. A summary of the HSST strategy is set out in Table 1, and the detailed assessment programme for Clinical Scientists in HSST is shown in Table 2. Table 1 also shows the methods by which each component is assessed.

The HSST assessment programme is designed to capture evidence of the Clinical Scientist's mastery of the three main components of HSST, reflecting the five domains of GSP.

1. Clinical/scientific skills, and values, behaviours and attitudes relating to professionalism and the delivery of scientific/clinical services (Domains 1 and 3).
2. Scientific content (Domain 2).
3. Contribution to research, innovation and leadership in healthcare science (Domains 4 and 5).

The purpose of the assessment programme is to:

- provide evidence of satisfactory acquisition and application of knowledge, skills, experience and professionalism relevant to practice;
- enable each Clinical Scientist in HSST to demonstrate readiness to progress through the training programme and generate feedback to inform progress and learning needs;
- help to identify Clinical Scientists in HSST who may be in difficulty and who may need additional support;
- provide evidence to inform an annual progression review and the completion of the workplace-based assessment component of HSST;
- gather evidence that would assure the public that the Clinical Scientist in HSST is ready for independent professional practice as a Consultant Clinical Scientist.

Approach and Methods of Assessment

Assessment for HSST is a blend of academic, professional and workplace-based assessments, which together provide evidence of the achievement of learning outcomes, clinical/scientific competence and the progression of the Clinical Scientist in HSST through to completion of training. All assessments are aligned to the curriculum and the domains of GSP. There are two routes through the HSST assessment programme to accommodate different requirements across the sciences: Route 1 is for Clinical Scientists in the Physiological Sciences, Physical Sciences and Biomedical Engineering, and Clinical Bioinformatics, and Route 2 is for Clinical Scientists in the Life Sciences. Table 1 shows that Clinical Scientists following Route 1 will complete assessments relating to the professional doctorate, an assessment of clinical skills, the workplace-based assessment programme and the ICS project. Clinical Scientists following Route 2 will be assessed through the

Fellowship Examination of the Royal College of Pathologists (FRCPath), the workplace-based assessment programme (with an option to take selected modules or the entire professional doctorate) and the ICS project.

Aim of the Innovation in Clinical Science Project

The aim of the ICS project is to allow Clinical Scientists in HSST to demonstrate the achievement of the learning outcomes of the ICS set out below by:

1. conceiving an innovation² in healthcare science that has the potential to make a positive contribution to service delivery, patient experience, patient outcomes, health economics, or any other aspect of healthcare. The Clinical Scientist's innovation should be at doctoral level and therefore must be original and make a new contribution to knowledge. It must not draw directly from work they may have submitted previously as part of a Master's degree or PhD – although the ICS project may contribute to the HSST professional doctorate or FRCPath dissertation;
2. undertaking a critical review of the literature considering relevant research in order to develop the rationale for the innovation;
3. undertaking a feasibility study, including consultation with stakeholder groups;
4. preparing and planning for implementation;
5. leading implementation and evaluation;
6. drawing realistic and evidence-based conclusions about the potential contribution and feasibility of the innovation.

Learning Outcomes from the ICS Project in the HSST Programme

The ICS project represents one component of the overall assessment strategy for the HSST programme that must be passed in order to receive the Certificate of Completion of Higher Specialist Scientist Training (CCHSST) from the NSHCS. All Clinical Scientists in HSST (including those taking the FRCPath route to completion of HSST) will need to complete the ICS. The project is designed to support the independent learning and demonstration of achievement of the following learning outcomes grouped under three areas, which reflect key components of the GSP syllabus as set out in the HSST curriculum.³

Professionalism and Professional Development (Domain 1)

By the end of the ICS project the Clinical Scientist in HSST will be able to demonstrate that they have:

- gained critical insight and professional understanding of the conceptual, ethical, value-based and analytical frameworks that underpin professional practice and their relationship to *Good Scientific Practice*;
- enhanced their skills and confidence to enable them to operate effectively and creatively within a healthcare science setting and the wider, diverse and changing healthcare environment.

Leadership and Quality Improvement in the Clinical and Scientific Environment (Domains 1, 2 and 5)

By the end of the ICS project the Clinical Scientist in HSST will be able to demonstrate that they have:

- broadened, built and applied their knowledge and skill base so that they are prepared for more senior, leadership roles within healthcare science and the wider healthcare environment where they will have responsibility as a future leader and team member for setting the policy, strategic direction, leadership and quality performance of their service and organisation to provide patient centred, high quality, compassionate patient treatment;

² Defined as 'An idea, service or product, new to the NHS or applied in a way that is new to the NHS, which significantly improves the quality of health and care wherever it is applied.' Improvement & Efficiency Directorate, Innovation and Service Improvement (2011, p9). *Innovation, Health and Wealth: Accelerating Adoption and Diffusion in the NHS*. Department of Health.

³ The domains indicated in the table relate to the AHCS's *Good Scientific Practice* document (<http://ahcs.flinthosts.co.uk/wordpress/wp-content/uploads/2013/09/AHCS-Good-Scientific-Practice.pdf>). Within every HSST curriculum is the detailed GSP syllabus that contextualises GSP to the level and practice of the Clinical Scientist in HSST.

- led a quality improvement programme/s within their clinical environment, using the knowledge, skills and experience of organisational leadership which demonstrate the behaviours and attitudes described in the current frameworks and models of excellent leadership.

Improving Outcomes for Health and Social Care (Domain 4)

By the end of the ICS project the Clinical Scientist in HSST will be able to demonstrate that they have:

- built on and developed the knowledge, skills and experience of research and innovation methodology to demonstrate the high level skills required to undertake doctoral level research.
- the criticality to explain the process, barriers and enablers for publication and implementation of research and innovation findings.

Overview of the ICS Project

The innovation may be developed from work that the Clinical Scientist in HSST has submitted as part of the professional doctorate, or FRCPath, or other HSST work, in consultation with their clinical supervisor. It is envisaged that completion of the ICS project will consist of the following stages.

- Stage 1** *Conception:* identify innovation, literature review, refine innovation and rationale.
- Stage 2** *Feasibility:* consultation with stakeholders, financial planning, implementation, plan, analysis of limitations and constraints.
- Stage 3** *Pilot testing:* critical analysis and evaluation, reformulation of innovation.
- Stage 4** *Assessment:* preparing for the ICS project assessment.

Clinical Scientists in HSST will not pass or fail the ICS project based on the success, or otherwise, of the innovation pilot alone, as it is recognised that innovations may succeed and fail due to factors that are outside the control of the Clinical Scientist. Similarly, it is recognised that Clinical Scientists are operating in a rapidly changing healthcare context and that the rationale for the innovation, or the innovation itself, may be superseded during the course of the project. The chief assessment criteria will therefore relate to the quality of the Clinical Scientist's insight into innovation and leadership in healthcare science, and the appropriateness of the conclusions drawn from their feasibility and pilot studies.

Annual Progression Review

It is a shared responsibility between the Clinical Scientist, their educational supervisor and the NSHCS to monitor and review satisfactory completion of all assessments. At the end of each year there will be a formal progression process that will consist of a meeting between the Clinical Scientist in HSST and their educational supervisor (Annual Progress Review; APR), and a formal meeting of the Annual Progression Review Board (APRB). These two processes will be overseen by the NSHCS and will be the means by which eligibility to progress through the five-year programme will be judged. As a summary of the processes:

- the APR will be conducted by the educational supervisor, using documentation, guidance, criteria and standards that are common across specialisms. The purpose of the APR is to discuss the Clinical Scientist's experiences and perceptions of progress, and to scrutinise evidence of the Clinical Scientist's performance in the workplace to enable the educational supervisor to make a recommendation to the APRB about progression. This may include a recommendation that additional support is required. A progression recommendation will also take into account any issues regarding the completion of HSST in a non-linear way, including consideration of equality and diversity issues.
- an APRB meeting will be convened for each HSST specialism and will involve representation from the NSHCS, the relevant professional body/bodies, Consultant Clinical Scientists and a lay representative. The role of the Board will be to review the recommendations from educational supervisors, the assessment results and any additional feedback from the providers of the professional doctorate (Route 1) or FRCPath (Route 2), the important value judgements made as part of MSF, and to complete a formal scrutiny of the evidence held on the OLAT. The purpose of the APRB is to ensure that the Clinical

Scientist in HSST has demonstrated sufficient evidence of achieving the learning outcomes and competences appropriate to the stage of the programme, and to confirm progression to the next year of training. Where the APRB is not able to confirm progression, the NSHCS will, with the guidance of the APRB representatives and the Clinical Scientist's educational supervisor, facilitate the implementation of a remediation and support process or, exceptionally, a HSST exit support strategy (which would require a review of evidence that the remediation and support process had not achieved the outcomes as specified by the APRB).

Table 1: Summary of HSST assessment strategy

Programme component	Route ¹	Assessment components	Assessment tool/s	Administrative responsibility ²	Component weighting
Mastery of scientific content	1	Professional doctorate (PD)	As required by the HEI provider of the PD	HEI	100%; must pass PD or FRCPATH to receive the Certificate of Completion for HSST from the NSHCS
	2	FRCPATH, with an option to take selected, or all, components of the PD ³	FRCPATH	RCPATH	
Mastery of clinical skills, values and behaviours	1	Workplace-based assessment (WPBA) Clinical skills assessment	Multiple WPBAs OSFA/OSCSA ⁴	Workplace, recorded on OLAT and monitored by NSHCS NSHCS (in collaboration with Medical Royal Colleges [MRCs] & Professional Bodies [PBs])	100%; must have evidence of satisfactory completion of all WPBAs, and gain a 'Pass' in the OSFA/OSCSA or FRCPATH to receive Certificate of Completion for HSST from the NSHCS
	2	WPBA FRCPATH	Multiple WPBAs FRCPATH	Workplace, recorded on OLAT and monitored by NSHCS RCPATH	
Contribution to innovation, service improvement, patient safety or quality management in healthcare science	1	Innovation in Clinical Science (ICS) project	Short report, plus presentation to multiprofessional panel	NSHCS to administer, in collaboration with MRCs and PBs	100%; must pass component to receive Certificate of Completion for HSST from the NSHCS
	2	Contribution to innovation, service improvement, patient safety, or quality management in healthcare science	Option to (1) complete as part of FRCPATH Part 2 (report and presentation to Penultimate Progression Review Board) or (2) complete ICS project as for non-Life Sciences ⁵	(1) RCPATH or (2) NSHCS to administer, in collaboration with MRCs and PBs	

¹ Route 1 is for Clinical Scientists in the Physiological Sciences, Physical Sciences and Biomedical Engineering and Clinical Bioinformatics; Route 2 is for Clinical Scientists in the Life Sciences.

² Where assessments are created and delivered by the NSHCS's partners, the School will request access to data about the performance of these assessments, and data on individuals' assessment outcomes.

³ Clinical Scientists taking the FRCPATH route through HSST have the option of completing any of the modules offered as part of the professional doctorate. However, in successfully completing the FRCPATH (and the ICS project, which may be part of the FRCPATH), the Clinical Scientist has demonstrated that they have achieved the learning outcomes of the professional doctorate.

⁴ Work is ongoing to establish whether an OSFA (Objective Structured Final Assessment) or OSCSA (Objective Structured Clinical Skills Assessment) is the best fit to the assessment purpose.

⁵ Clinical Scientists in Life Sciences who choose not to undertake the innovation component as part of FRCPATH will be required to complete the ICS project, which will require the production of a short report and presentation to a multiprofessional panel.

Table 2: HSST assessment road map for Life Sciences

Stage	Year	Professional Doctorate	FRCPATH	Formative assessment	Summative assessment	Annual Progression Review (APR)/Annual Progression Review Board (APRB)	Completion
1	1	OPTIONAL; completion in part or whole to be determined by the CS in consultation with their educational supervisor	Part 1 ³	As available for FRCPATH and in workplace	12 DOPS ¹ ; 1 MSF; FRCPATH Part 1	APR, plus APRB ²	APRB, to include completion of FRCPATH Part 1 if completing in Year 1
	2			As available for FRCPATH and in workplace	12 DOPS ¹ ; 1 MSF; FRCPATH Part 1	APR, plus APRB ²	APRB, to include completion of FRCPATH Part 1 if completing in Year 2
2	3		Part 2 ³	As available for FRCPATH and in workplace	8 OCEs; 4 CBDs ¹	APR, plus APRB ²	APRB
	4			As available for FRCPATH and in workplace, plus local assessment of contribution to innovation, service improvement, patient safety or quality management in healthcare science (to be completed as part of FRCPATH Part 2 or ICS project for non-Life Sciences)	8 OCEs; 4 CBDs ¹ ; 1 MSF; Innovation contribution	APR, plus APRB ³	APRB, including assessment of innovation as part of FRCPATH Part 2 or ICS project for non-Life Sciences
	5			As available for FRCPATH and in workplace	FRCPATH Part 2 exam; 1 MSF	Final Review Board (FRB) ³	FRB, to include pass FRCPATH Part 2
NSHCS awards the Certificate of Completion upon submission of evidence of successful completion of the WPBA programme, the FRCPATH, and innovation component (as part of FRCPATH or ICS project)							

¹ The number of workplace-based assessments is indicative only; as is the scheduling of DOPS, CBDs and OCEs across Stages 1 and 2. There is no requirement to complete a minimum number of WPBAs, or any requirement to complete certain assessments at particular stages of the programme. Clinical Scientists in HSST should discuss and negotiate with their educational supervisor, as part of the development of the training plan, the type and number of assessments that will be most appropriate to demonstrate achievement of the learning outcomes.

² Criteria for progression to be determined in consultation with stakeholders.

³ Clinical scientists taking FRCPATH should aim to take Part 1 during Year 1 or Year 2, and Part 2 during the remaining years.

The Online Learning and Assessment Tool (OLAT)

Every Clinical Scientist in HSST will need to develop and maintain an electronic learning portfolio (e-portfolio) to document and provide evidence of their progress through the training programme. The framework for the e-portfolio will be the OLAT, which is provided by the NSHCS. The OLAT will enable the Clinical Scientist in HSST to record all workplace-based assessments, supervisors' reports, multisource feedback outcomes and reflections on their progress, learning experiences and participation in learning events, such as journal clubs and national and international conferences, etc. The OLAT is also designed to facilitate and encourage ongoing dialogue between the Clinical Scientist in HSST and their supervisor about the Clinical Scientist's personal and professional development at consultant-level practice. Clinical Scientists in HSST will be given access to OLAT upon enrolment.

Acknowledgements

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GOOD SCIENTIFIC PRACTICE SYLLABUS: A COMMON COMPONENT OF ALL HSST CURRICULA

This syllabus must be followed throughout the whole training period, with engagement at the appropriate level, depending on the stage of training.

The syllabus is divided into five domains. These align with the five domains of Good Scientific Practice:

- Domain 1: Professional Practice
- Domain 2: Scientific Practice
- Domain 3: Clinical Practice
- Domain 4: Research, Development and Innovation
- Domain 5: Clinical Leadership

Each domain contains an overall Learning Objective, which is described by a number of Competence statements. These are presented as:

- Knowledge to be acquired and applied
- Practical skills to be demonstrated
- Attitudes and behaviours to be consistently displayed

Each Competence statement is supported by indicative content. Cross referencing of the syllabus to the *Good Scientific Practice* standards is included.

Modernising Scientific Careers: Higher Specialist Scientific Training: Good Scientific Practice Syllabus

Domain 1: Professional Practice

Topic	Professional Practice	GSP Reference
Learning Objective	By the end of the training programme the HSS Trainee will be able to exercise personal responsibility and work largely autonomously taking the initiative in complex and unpredictable situations and performing a range of clinical/practical skills consistent with the roles and responsibilities of a Consultant Clinical Scientist.	
Knowledge	<p>By the end of the training period the HSS Trainee will be able to:</p> <ol style="list-style-type: none"> Justify the importance of placing the patient at the centre of care and considering services from a user's point of view <ul style="list-style-type: none"> Compare and contrast models of promoting patient-centred care and how to ensure that the wishes, beliefs, concerns, expectations and needs of patients are respected. Critique studies that demonstrate the benefits of patients sharing in decision making on their health. Defend the rights of patients and carers to treatment without discrimination which includes age; gender; illness; disability; health inequality; cultural and social inequality; diversity. Critique the evidence base, principles and practice of patient-centred interviewing and examination, including the patient perspective. Explain and justify why it is important to develop and maintain appropriate patient-professional relationships and evaluate a range of situations which have had a positive and negative impact on those relationships. Explain and justify why it is important to have a holistic approach to the patient, recognising that there may be social as well as medical aspects to their management. Summarise local guidelines for responding to complaints from patients and/or carers and evaluate the impact of these systems in promoting patient centre care. Recognise the importance of gathering and responding to patient derived data. Summarise local guidelines for responding to unacceptable behaviour by patients, carers or relatives, including harassment, bullying or violence and identify the strengths and weaknesses of these guidelines. Defend the importance of public engagement in science and its role in health and society. Critically evaluate the important to keeping professional knowledge and skills up to date and work within the limits of personal competence <ul style="list-style-type: none"> Create, interpret and construct new knowledge of scientific, clinical and professional developments in area of practice. Justify the rationale for engaging in continuing professional development and critical reflective practice and evaluate a range of methods for recording learning and developing and evaluating action plans. Critique the evidence base underpinning continuing professional development with respect to the Consultant Clinical Scientist, the clinical service and the patient. Recognise the limits of own competence and scope of practice in order to make informed and reasonable decisions. Recognise the limits of competence and scope of practice for those for whom you are responsible and evaluate methods for 	<p>1.1.1 1.1.9 1.1.10 1.2.1</p> <p>1.1.3 1.1.4 1.1.5 1.1.7 1.2.5 3.1.5 3.1.17</p>

Topic	Professional Practice	GSP Reference
	<p>managing difficult and sometimes unpredictable situations.</p> <ul style="list-style-type: none"> • Critique methods for evaluating audit and review information on performance of self and those for whom you are responsible. 	
	<p>3. Critique the ethical, legal and governance requirements arising from working at the level of Consultant Clinical Scientist across a range of complex situations</p> <ul style="list-style-type: none"> • Evaluate the principles, guidance and law with respect to medical ethics; patient confidentiality; informed consent; equality and diversity; child protection; use of chaperones. • Justify the role of the Consultant Clinical Scientist in the definition and monitoring of compliance of standards of practice that are ethical and legal often involving complex issues. • Defend the purpose of clinical governance and the requirements of employing organisation. • Evaluate the role of clinical audit in demonstrating compliance with local governance requirements. • Evaluate the effectiveness of the Standards of Proficiency and Standards of Conduct, Performance and Ethics of the Health and Care Professions Council. 	<p>1.1.3 1.2.5 3.1.1 3.1.2 3.1.3 3.1.17</p>
	<p>4. Summarise and critique the evidence to support the high levels of probity required when working at the level of Consultant Clinical Scientist as a clinical leader</p> <ul style="list-style-type: none"> • Evaluate the importance of verifying information in reports and documents, including research • Analyse and justify the Health and Care Professions Council Standards of Conduct Performance and Ethics • Appraise approaches to procedures for identifying and reporting critical incidents. • Appraise approaches to procedures for receiving and responding to complaints. • Summarise the procedures to follow if cautioned, charged with a criminal offence, suspended or have restrictions placed on personal scientific, clinical or professional practice. 	<p>1.2.3 1.2.4 1.2.5</p>
	<p>5. Appreciate the importance of personal health and wellbeing in order to ensure that personal performance and judgement is not affected by own health</p> <ul style="list-style-type: none"> • Responsibilities to the public and how these may be compromised by poor health • Effects of stress on professional performance • Role and availability of occupational health and other support services 	<p>1.1.8 1.1.9 1.2.2</p>
	<p>6. Analyse NHS organisation, policy and practice as it affects the provision of healthcare, healthcare science and the patients and populations it serves</p> <ul style="list-style-type: none"> • Justify the contribution the NHS makes to assure the health of the nation. • Critically evaluate the structure of the NHS in the relevant jurisdiction of the UK, including Department of Health, Health Boards and Authorities Primary Care Trusts and Hospital Trusts and compare and contrast to alternative models of health delivery in Europe or Internationally. • Evaluate current national and local policy issues as they affect the service provided by Clinical Scientists and the healthcare science workforce. • Justify the role of population screening, shared care and self care in diagnosing and managing disease from the perspective 	<p>1.1.3 3.1.3</p>

Topic	Professional Practice	GSP Reference
	<p>of the patient and the healthcare provider.</p> <ul style="list-style-type: none"> • Identify and explain the finance issues facing providers of healthcare at national and local level in general, especially budgetary management and commissioning and the effect on healthcare provision. • Evaluate the effectiveness of the role of central government health regulatory and quality improvement agencies across the devolved NHS. • Explain and analyse the roles and relationships of Health Education England (and equivalents elsewhere in the UK); Modernising Scientific Careers; Academy for Healthcare Science; National School of Healthcare Science; Council of Healthcare Science in Higher Education, Medical Royal Colleges; specialist societies; postgraduate deans and deaneries and patient organisations in the provision of healthcare science. • Summarise the management structure and key contacts of the employing organisation (including chief executive, medical directors, clinical directors) and evaluate the structure with respect to providing high quality patient care. • Summarise the management structure of and key contacts with relevant major service users and providers and the contribution to the provision of high quality patient care. <p>7. Discuss theories of teaching and learning to underpin the role of the healthcare scientists in education as a teacher or trainer, according to the best contemporary clinical and educational standards.</p> <ul style="list-style-type: none"> • Critically review the evidence base and apply knowledge of teaching, learning and assessment within the clinical and scientific work base to design, deliver and evaluate education and training programmes that meet the best clinical and educational standards. 	<p>1.4.1 1.4.2</p>
<p>Practical Skills</p>	<p>By the end of the training period HSS Trainees would be expected to apply in practice a range of clinical skills and critically reflect on their performance and will be able to:</p> <p>1. Critically apply their understanding of professional practice with conduct that places the patient at the centre of care in a manner that promotes patient well-being and self-care through:</p> <ul style="list-style-type: none"> • Developing and maintaining appropriate patient-professional relationships in practice. • Working with patients and carers in a respectful and non-discriminatory manner. • Taking a clinical history and using the information as part of the clinical decision making process. • Performing a range of clinical examination skills relevant to healthcare science practice. • In the context of patient-centred care giving and receiving feedback sensitively to or from a peer or colleague using an appropriate feedback model. <p>2. Critically apply their understanding of the role and importance of continuing professional development to ensure that professional knowledge and skills are being kept up to date through:</p> <ul style="list-style-type: none"> • Maintaining personal records of continuing professional development providing evidence of critical reflection including action planning with respect to clinical practice and professional development in a form suitable for audit by a professional body or regulator and demonstrate continuing fitness to practise. • Recording critical reflective notes justifying how participation in continuing professional development has contributed to learning and led to improvements in personal and service performance. 	<p>1.1.2 1.1.10 1.1.11 3.1.10 3.1.11</p> <p>1.1.4 1.1.5 3.1.5</p>

Topic	Professional Practice	GSP Reference
	<ul style="list-style-type: none"> • Monitoring own performance by evaluating the outcome of audit and feedback from a range of sources. • Encouraging a culture in which innovation and developments are identified, discussed, evaluated and potentially introduced to improve service delivery. • Encouraging staff and colleagues to recognise learning opportunities in the work place and where necessary supporting them to obtain and use study leave to participate and contribute to additional learning experiences including skills training courses and conferences. <p>3. Respond to the ethical, legal and governance requirements arising from working at the level of Consultant Clinical Scientist critical applying accrued knowledge and evidence by:</p> <ul style="list-style-type: none"> • Recognising the factors influencing ethical decision making, including religion, personal and moral beliefs, cultural practices making informed decisions and supporting colleagues. • Justifying the use and sharing of information in accordance with the regulations, encouraging such behaviour in other members of the healthcare team and taking action where breaches of the guidelines make have occurred. • Justifying the use and promotion of strategies to ensure confidentiality is maintained e.g. removal of patient names where appropriate reviewing and analysing published literature and considering the impact of such measures on the clinical service. • Recognising the problems posed by disclosure in the public interest, without consent of the patient • Ensuring patients, relatives and carers are aware of the need for information distribution within members of the immediate healthcare team. • Using appropriate methods of ethical reasoning to justify a decision where complex and conflicting issues are involved. • Perform and evaluate clinical audit to assess compliance with local governance requirements. Take remedial action as required. <p>4. At all times act in a manner that demonstrates probity in all aspects of professional practice by:</p> <ul style="list-style-type: none"> • Working in accordance with good scientific practice with conduct that at all times justifies the trust of patients and colleagues and that maintains public trust in healthcare science. • Writing honest and accurate reports and signing documents appropriately. • Applying honesty and accuracy about personal qualifications, experience and position in the scientific community. • Acting honesty with respect to written and verbal information provided to any formal or legal enquiry, including recognition of the limits of scientific knowledge and experience. • Creating and justifying open and non-discriminatory professional working relationships with colleagues and using critical reflection to review personal behaviour and response to challenging issues. • Responding in an open, constructive and timely manner to critical incidents or complaints about own or team performance influencing the response and using critical reflection to review personal behaviour and response to challenging issues. • Taking appropriate action if you suspect you or a colleague may not be fit to practise putting patient safety at the forefront of your practice. • Practising within the Health and Care Professions Council Standards of Conduct, Performance and Ethics. <p>5. Make appropriate judgements to ensure you limit your work or stop practising if performance or judgement is affected by your</p>	<p>1.1.11 3.1.1 3.1.2 3.1.17</p> <p>1.1.8 1.2.2 1.2.3 1.2.4 1.2.5 5.1.3</p> <p>1.1.8</p>

Topic	Professional Practice	GSP Reference
	<p>health by:</p> <ul style="list-style-type: none"> • Recognising when personal health takes priority over work pressures, seeking appropriate advice and support and taking appropriate action. • Developing and maintaining appropriate coping mechanisms for a range of potential issues including stress seeking help if appropriate and evaluating the impact of an intervention. <p>6. Demonstrate professional practice that is consistent with relevant current NHS policy and practice by:</p> <ul style="list-style-type: none"> • Identifying and evaluating existing and new NHS policy and advice that are relevant to the area of practice and the implications of these for personal and team practice and the impact on patients. • Using a range of communication skills to lead and contribute to discussions and gain agreement in a range of situations, including within the multidisciplinary team and steps that need to be taken to align service delivery with the most recent NHS policy and advice. • Sharing information and advice with peers in order to encourage a consistent approach to the implementation of NHS policy and advice. • Evaluating, documenting and justifying any local decisions that are taken that mean that it is not possible to align service delivery with NHS policy and advice. <p>7. Contribute to the education and training of colleagues planning, delivering and evaluating teaching on the basis of student and peer feedback and active self reflection</p> <ul style="list-style-type: none"> • Use a range of teaching methods including lecture based, small group teaching and practical skills teaching appropriate to the learners. • Plan, deliver and evaluate a range of assessments appropriate to learning outcomes in the three domains of learning. 	<p>1.1.11</p> <p>1.1.4 1.3.1 2.1.1 2.1.6</p> <p>1.4.1 1.4.2</p>
<p>Attitudes and Behaviours</p>	<p>By the end of the training period HSS Trainees would be expected to demonstrate the attitudes and behaviours necessary for the role of a Consultant Clinical Scientist and will be able to:</p> <p>1. Apply evidence based personal and team professional practice that places the patient at the centre of care</p> <ul style="list-style-type: none"> • Act in accordance with the principles and practice of patient-centred care, regularly reflecting on personal practice and revising judgments and changing behaviour in the light of new evidence. • Critically assess and evaluate personal and team related performance in the context of evidence based patient care identify areas of good practice and make improvements where necessary. • Seek and critically appraise feedback from patients on own and team performance and adapt practice accordingly. <p>2. Apply knowledge, experience and deep reflection to identify personal development needs using a range of tools and develop and update action plans to ensure support continuing professional development</p> <ul style="list-style-type: none"> • Apply the skills of deep reflection to identify personal development needs to transform and maintain up to date practice. • Act as a self-motivated professional scientist being willing to learn from self and others responding positively to constructive and meaningful feedback. • Create a culture which values continuing professional development to enable staff under supervision and supports them in recognising their strengths and identifying areas for improvement. 	<p>1.1.9 1.1.10 1.1.11</p> <p>1.1.4 1.1.11 1.3.1 1.3.6</p>

Topic	Professional Practice	GSP Reference
	<p>3. Display a professional commitment to ethical practice consistently operating within national and local ethical, legal and governance requirements</p> <ul style="list-style-type: none"> • Accept professional ethical standards and encourages informed debate and critical reflection within healthcare teams. • Seek advice of peers, legal bodies and regulators in the event of ethical dilemmas in areas including disclosure and confidentiality. • Respect requests from patients that information should not be shared unless this puts the patient or others at risk of harm. • Share information about patient care with the patient unless they have expressed a wish not to receive such information. <p>4. Apply the principles of <i>Good Scientific Practice</i> and the professional standards performing to the highest standards of personal behaviour in all aspects of professional practice</p> <ul style="list-style-type: none"> • Recognise the importance of leading by example in setting high standards of personal behaviour, and in acting with openness, fairness and integrity listening to the views of others. • Accept the requirements for professional regulation. • Promote professional attitudes and values at all times. • Recognise the need to be truthful and to admit and learn from errors. • Accept the requirement to inform the statutory regulator if cautioned, charged with a criminal offence, suspended or have restrictions placed on personal scientific, clinical or professional practice. <p>5. Consistently operate in accordance with relevant current NHS policy and practice</p> <ul style="list-style-type: none"> • Recognise the need to identify and assess the implications of NHS policy and advice for service organisation and delivery of high quality services. • Consult with peers and service users as part of obtaining agreement to align services with NHS policy and advice. 	<p>1.1.11 1.2.1</p> <p>1.1.3 1.1.8 1.1.9 1.1.11 1.2.2</p> <p>1.1.3 1.3.1</p>

Domain 2: Scientific Practice

Topic	Scientific Practice	GSP Reference
Learning Objective	By the end of this stage of training HSS Trainees will be able to assess, plan, deliver and evaluate high quality scientific services in a safe and secure working environment.	
Knowledge	<p>By the end of the training period HSS Trainees will be able to:</p> <ol style="list-style-type: none"> 1. Analyse the strengths and weaknesses of current and new scientific investigations and methods used in the diagnosis, monitoring and treatment of clinical disorders relevant to area of practice <ul style="list-style-type: none"> • Evaluate the scientific basis of investigations and procedures. • Discuss the impact of genomics and personalised medicine on health and healthcare science. • Discuss the impact of clinical bioinformatics on health and healthcare science. • Critique the application of scientific investigations and procedures in protocols and patient pathways. • Summarise the strengths and weaknesses of current service provision both in terms of performance characteristics and clinical application. • Compare alternative approaches and/or improvements to investigations and procedures. • Use scientific principles and reasoning to assess, plan and design new or improved investigations or procedures. • Analyse the role of peer opinion in refining ideas and plans. • Evaluate new and emerging technologies and their potential to improve healthcare and healthcare science. 2. Critique the application of evidence-based practice to the optimisation of scientific investigations and methods <ul style="list-style-type: none"> • Summarise and critically review the scientific literature in area of expertise. • Evaluate the principles and practice of evidence-based medicine relevant to area of practice. • Appraise approaches to meta-analyses, systematic reviews, clinical trials, cohort studies and related approaches used in this field. • Critique methods for searching, identifying, ranking and evaluating scientific evidence. • Justify the rationale for the use of methods to evaluate and optimise the performance of scientific investigations. • Defend methods for comparing performance of two or more scientific investigations or procedures. • Appraise relevant statistical measures applied to research publications. 3. Evaluate and apply information and communication technology to facilitate service delivery and development in relevant areas of healthcare science <ul style="list-style-type: none"> • Justify the application of information and communication technology in area of practice. • Evaluate the impact and development of bioinformatics on the practice of health care and healthcare science. • Discuss the requirement for data confidentiality, security and protection. • Evaluate the function and operation of the Hospital Information System. • Evaluate and justify the function and operation of linked information systems (e.g. Laboratory Information System) and middleware linking equipment to information systems. 	<p>2.1.1 2.1.3</p> <p>1.1.5 2.1.1</p> <p>2.2.9</p>

Topic	Scientific Practice	GSP Reference
	<ul style="list-style-type: none"> • Identify the benefits and barriers with respect to personal computer hardware and software. • Appraise the appropriate use of electronic mail and social networking technology in the context of professional role. • Summarise how electronic literature searching (e.g. PubMed) and storage can be used within the clinical environment. • Access and judge specialist websites and databases relevant to professional role. • Appraise the range of statistical packages relevant to area of expertise, including bioinformatics where appropriate. <p>4. Justify the principles and practice of quality control, external quality assessment and quality management as applied to relevant areas of healthcare science</p> <ul style="list-style-type: none"> • Evaluate the purpose and operational requirements of internal quality control and external quality assessment and defend the systems currently in place. • Defend the principles and practice of quality management and, where appropriate, service accreditation. • Critique the required quality standards and monitoring of performance against those standards and the contribution standards make to the provision of a high quality service. <p>5. Justify the role of audit and the audit cycle and explain how it is used as a tool to facilitate continuous quality improvement</p> <ul style="list-style-type: none"> • Evaluate the principles and practice of scientific and technical audit including examples of audit improving practice. • Identify aspects of service delivery that should be subjected to regular scientific or technical audit and justify the selection. • Appraise audit reports including recommendations for improvement and the impact on the service when implemented. • Critically review examples of relevant scientific and technical audits performed locally or elsewhere and the impact on service delivery. <p>6. Summarise and interpret health and safety legislation and guidance for the workplace</p> <ul style="list-style-type: none"> • Defend the importance of health and safety within the workplace with respect employees, employers, patients and the public. • Appraise current legislation and guidelines relating to health and safety in the workplace including, as appropriate to role, biological specimen handling; COSHH; RIDDOR; radioactivity; fire safety; electrical safety; moving and handling; display screen equipment. • Justify local health and safety guidance. • Justify the principles and practice of infection control including the impact of reducing infection rates on patients. • Critically review procedures involved in risk assessment and risk management and the impact on quality and safety. • Summarise the policy and procedures associated with critical incident reporting and the impact on service improvement and the culture of the organisation. 	<p>2.3.1 2.3.2</p> <p>2.2.2 2.3.4 3.1.17</p> <p>2.2.6 2.2.7 2.2.8</p>
Practical Skills	<p>By the end of the training period HSS Trainees would be expected to apply in practice a range of clinical skills and critically reflect on their performance and will be able to:</p> <p>1. Develop and evaluate investigative strategies/procedures/processes that take account of relevant clinical and scientific evidence and other sources of information</p> <ul style="list-style-type: none"> • Critically appraise the scientific credentials and validity of existing investigations and procedures. • Critically appraise the way in which scientific investigations and procedures are used in strategies and protocols for the 	<p>2.1.1 2.1.3 2.2.2</p>

Topic	Scientific Practice	GSP Reference
	<p>diagnosis, monitoring and treatment of defined clinical disorders.</p> <ul style="list-style-type: none"> • Work in partnership with peers and service users apply scientific principles and reasoning to plan, develop and assess the scientific validity and clinical effectiveness of new or improved investigations, procedures, strategies or protocols. <p>2. Critique the selection and application in practice of scientific investigations in defined clinical situations using quantitative and/or qualitative methods</p> <ul style="list-style-type: none"> • Reflect on proficiency in the performance of routine and non-routine scientific and technical procedures used in defined clinical areas of service and develop action plans to improve performance. • Compare own proficiency with experts in the technical validation of data derived from scientific and technical procedures. • Justify the selection and application of scientific and technical procedures to comply with clinical requests and evaluate the efficacy of this n own practice. • Apply the principles and practice of evidence-based medicine to critically appraise the effectiveness of scientific and technical investigations and procedures. • Use and evaluate statistical measures such as likelihood ratio, AUC-ROC, number needed to treat/harm. <p>3. Master the use of information and communication technology in relevant areas of healthcare science</p> <ul style="list-style-type: none"> • Use information and communication technology for all applications in area of practice. • Justify the rationale and conform to requirements for data confidentiality, protection and security. • Use and apply the Hospital Information System; appropriate linked information systems; middleware and instrumentation hardware and software. • Master the use of personal computers and relevant programmes including word processing; databases; PowerPoint; internet and electronic mail; electronic literature searching and storage. • Use relevant statistical packages for data handling including methods for assessing clinical effectiveness and, where appropriate, basic bioinformatics and interpret the results/outcomes. <p>4. Set, apply and maintain quality standards and related quality control, assessment and management techniques to assure the validity of scientific and technical investigations adapting and developing systems as required</p> <ul style="list-style-type: none"> • Critically appraise relevant internal quality control and external quality assessment data and draw conclusions about quality performance. • Present and actively participate in meetings that review quality performance criteria justifying and defending solutions for improvement and adapting and implementing corrective action as required. • Contribute to quality management justifying the definition of standards and monitoring of performance against those standards adapting and developing systems as required. • Prepare and review regular quality management reports including, where appropriate, linkage with service accreditation adapting and developing systems as required. <p>5. Perform scientific and technical audit to determine that investigations and methods are fit for purpose justifying and monitoring the impact of recommendations</p>	<p></p> <p>2.1.2 2.1.3 2.1.4 2.2.1 2.2.3 2.2.4 2.2.5</p> <p>2.2.9</p> <p>2.1.6 2.3.1 2.3.2 2.3.3</p> <p>2.2.2 2.3.4</p>

Topic	Scientific Practice	GSP Reference
	<ul style="list-style-type: none"> • Perform scientific and technical audit of the performance and effectiveness of scientific investigations and service delivery in accordance with local guidelines. • Identify, critically review and communicate the outcomes of scientific and technical audits performed by others in relevant areas of scientific investigation and service delivery making recommendations for changes and monitoring the impact of those recommendations. • Devise, develop, perform and evaluate scientific and technical audits in own area of expertise reporting the outcomes including learning, modifications and the impact on service delivery resulting from the audit. <p>6. Promote the importance of health and safety standards in the workplace and identify and justify actions that will improve health and safety and reduce the risk of infection</p> <ul style="list-style-type: none"> • Perform work place role complying with current legislation and guidelines relating to health and safety in the workplace. • Adhere to local health and safety guidance. • Perform work place role in accordance with the control of infection regulations. • Perform risk assessment and risk management of health and safety in the workplace, make recommendations and monitor the impact of the recommendations. • Comply with requirements for critical incident reporting reflecting on and learning from the occurrence and outcome of critical incidents adapting practice as necessary. • Investigate and respond to reported health and safety incidents in the workplace. 	<p>3.1.17</p> <p>2.2.6 2.2.7 2.2.8</p>
Attitudes and Behaviours	<p>By the end of the training period HSS Trainees would be expected to demonstrate the attitudes and behaviours necessary for the role of a Consultant Clinical Scientist and will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate current debates in the field and critically appraise scientific developments in area of expertise <ul style="list-style-type: none"> • Appreciate and utilise a range of approaches to identify, critically review and learn from new and emerging scientific literature in area of expertise. • Make appropriate judgements in order to search and archive scientific literature. • Engage in critical dialogue on the latest scientific developments (e.g. journal clubs). • Development of planning and critical appraisal skills in self and clinical team through peer review, shared exercises and case review. 2. Apply evidence-based scientific practice as a means of improving patient investigation and care where necessary revising judgements and changing behaviour in light of new evidence <ul style="list-style-type: none"> • Critically evaluate the application of the principles of evidence-based medicine across areas of expertise. • Apply rigorous scientific critiques to the evaluation of data related to clinical practice in the support of clinical decision making and patient management. 3. Evaluate and use information and communication technology to improve service quality and delivery <ul style="list-style-type: none"> • Use new information and communication technology changing practice and behaviour as appropriate. • Justify the need to balance data confidentiality, security and protection and the sharing of data with relevant stakeholders 	<p>1.1.5 2.1.6 3.1.5</p> <p>1.1.5 2.1.5 2.1.6</p> <p>2.2.9</p>

Topic	Scientific Practice	GSP Reference
	<p>including patients to ensure high quality patient-centred care.</p> <p>4. Listen, influence and lead continuous quality improvement in scientific services</p> <ul style="list-style-type: none"> • Justify the importance of continuous quality improvement using the available evidence base. • Influence, lead and support staff in the department/organisation to create a culture that recognises the importance of quality and quality improvement in the delivery of scientific services. • Justify the importance of quality control and quality assessment of all investigations and services influencing and shaping the views of others. • Create opportunities for staff to receive training in quality management by justifying the impact of training on service delivery and personal development. <p>5. Appreciate and utilise audit as a tool to evaluate and optimise scientific services</p> <ul style="list-style-type: none"> • Defend scientific and technical audit as a valid tool to improve scientific investigation and service delivery. • Identify training needs of self and others and develop training plans to enable audit to proceed. • Communicate outcomes of scientific and technical audits with peers, managers and other interested parties persuading others to implement and/or adapt recommendations in their area of practice. <p>6. Establish and influence the culture of health and safety in the workplace</p> <ul style="list-style-type: none"> • Create a culture of health and safety awareness, identification and resolution of issues and modification of systems to enhance health and safety. • Review and report on health and safety issues sharing good practice with individuals, the team and wider organisation. • Identify, justify and create opportunities for staff to receive health and safety and first aid training and monitors the learning and impact of the training on the individual and service. 	<p></p> <p>2.3.2 2.3.3</p> <p>2.2.2 2.3.4 3.1.17</p> <p>2.2.6 2.2.7 2.2.8</p>

Domain 3: Clinical Practice

Topic	Clinical Practice	GSP Reference
Learning Objective	By the end of this stage of training, HSS Trainees will be able to assess, plan, deliver, interpret, report and evaluate high quality clinical services that are targeted to meet the needs of individual and groups of patients.	
Knowledge	By the end of the training period HSS Trainees will be able to: <ol style="list-style-type: none"> 1. Analyse the strengths and weaknesses of the procedures required to deliver high quality clinical practice in the investigation and management of patients <ul style="list-style-type: none"> • Justify the requirement for patient consent for investigation including patients who lack capacity and provide advice to others. • Summarise the requirement to maintain patient confidentiality and respect for patients' privacy involving the patient appropriately and the circumstances when disclosure is allowed. • Justify the rationale of clinical coding and the need for accuracy and use of medical terminology. • Analyse and justify the wider clinical consequences of clinical investigations performed and clinical advice provided. • Relate understanding of setting clinical priorities and time management for patient investigation • Interpret emerging evidence and knowledge that adds to the clinical evidence base underpinning services provided in order to make informed judgements. • Justify the requirements for accurate record keeping and data security. • Summarise the role of standard operating procedures; clinical protocols; clinical guidelines to promote a safe, patient centred environment and underpin high quality scientific services. • Identify common sources of error; identification of risk; critical incident reporting and analyse how this information can be used to improve services and reduce incidents and risk. • Justify the importance of adopting a no blame culture for identification and investigation of error. 2. Relate understanding of the aetiology of relevant clinical disorders as a means to developing appropriate clinical investigations across the full range of patients accessing the clinical services of personal area of practice <ul style="list-style-type: none"> • Describe the detailed aetiology of clinical disorders in area of expertise and apply knowledge when selecting investigative strategies. • Analyse the strengths and weaknesses of existing clinical investigations and identify and critically appraise potential strategies to improve or develop new clinical investigations in the best interests of patients. 3. Discuss and evaluate how the results of clinical investigations may be related to defined disorders and patient management strategies across the full range of patients accessing the clinical services of personal area of practice <ul style="list-style-type: none"> • Summarise the use of normal limits and describe the levels of uncertainty in the outcome of clinical investigations. • Analyse patterns of data and results obtained from clinical investigations linked to defined clinical disorders. • Evaluate and justify the use of statistics and predictive values in clinical practice recognising potential limitations. • Evaluate the effectiveness of relevant clinical guidelines and patient pathways recognising potential limitations and seeking alternatives. 	3.1.1 3.1.2 3.1.3 3.1.4 3.1.5 3.1.6 3.1.15 3.2.1 3.2.2 3.1.5 3.1.6 3.1.7 3.1.4 3.1.12 3.1.13 3.2.4

Topic	Clinical Practice	GSP Reference
	<p>4. Evaluate the role of the multidisciplinary clinical team in optimising clinical outcomes for individual and groups of patients</p> <ul style="list-style-type: none"> • Discuss the role of the multidisciplinary clinical team and evaluate the effectiveness of the team. • Summarise the range of multidisciplinary clinical teams supported by healthcare science and analyse the role of each team. • Justify the operational requirements for individual multidisciplinary clinical teams and evaluate the clinical effectiveness of the team and suggest areas for improvement. <p>5. Discuss and evaluate the principles and practice of clinical audit as a tool to evaluate the effectiveness of services provided</p> <ul style="list-style-type: none"> • Principles and practice of clinical audit. • Resources available in local organization to support clinical audit. • Examples of relevant clinical audits performed locally or elsewhere. 	<p>1.3.2 1.3.3 3.1.14 3.1.16</p> <p>2.2.2 3.1.17</p>
<p>Practical Skills</p>	<p>By the end of the training period HSS Trainees would be expected to apply in practice a range of clinical skills and critically reflect on their performance and will be able to:</p> <p>1. Apply in practice consistent high standards of clinical practice in the investigation and management of patients and critically reflect on your performance</p> <ul style="list-style-type: none"> • Explain and justify the recommended clinical investigations involving the patient wherever possible. • Explain and justify the procedures for preparing samples for clinical investigation. • Master a range of clinical investigations relevant to area of practice complying with relevant standard operating procedures, clinical protocols and clinical guidelines in accordance with best practice. • Produce and maintain clear, accurate and legible records in accordance with the regulations/guidelines governing patient consent, confidentiality and data security. • Analyse the outcome of clinical investigation and give immediate feedback in accordance with agreed protocol. <p>2. Plan, develop, perform, evaluate, interpret and report a range of clinical investigations to assist with the diagnosis, monitoring and treatment of patients making informed judgements as necessary</p> <ul style="list-style-type: none"> • Comply with quality standards in the performance of routine and non-routine clinical investigations in area of practice. • Identify and critique opportunities to develop and/or improve clinical investigations to improve patient experience and/or to add certainty to the outcome following relevant governance procedures and acting on advice and feedback from patients. • Plan, develop and critically evaluate modified or improved clinical investigations producing valid comparative data with existing procedure involving the views of patients or service users. • Discuss outcomes, modifications or improved clinical investigations with patients or service users before agreeing on whether to implement a change in procedure in adhering to governance processes. <p>3. Provide advice on the clinical significance of the results of investigations including, where appropriate, follow up and further investigation and reflect on the process and justify the advice given</p> <ul style="list-style-type: none"> • Interpret and report the outcomes of routine and non-routine clinical investigations in the context of the clinical presentation of individual patients justifying the conclusions. • Provide clear and accurate written and/or verbal clinical advice on the clinical significance of investigations having regard to 	<p>1.1.1 1.1.11 3.1.1 3.1.2 3.1.3 3.1.4 3.1.5</p> <p>3.1.6 3.1.7 3.1.8 3.1.10 3.1.11 3.1.15 3.2.1 3.2.2 3.2.3</p> <p>3.1.12 3.1.13 3.1.14 3.2.3 3.2.4</p>

Topic	Clinical Practice	GSP Reference
	<p>the importance and urgency for patients and the underpinning evidence base.</p> <ul style="list-style-type: none"> • Discuss with relevant medical and other healthcare practitioners the follow up, further investigation and/or appropriate treatment of individual patients based on the outcomes of clinical investigations and current best practice/evidence. <p>4. Actively participate in multidisciplinary clinical team meetings that review clinical outcomes for individual and groups of patients challenging decisions/recommendations when necessary</p> <ul style="list-style-type: none"> • Use the evidence base to identify multidisciplinary clinical teams in area of expertise that would benefit from input from a senior Healthcare Scientist and make arrangements for participation to influence the judgements of the team. • Participate in a proactive manner to the conduct of multidisciplinary clinical teams identifying opportunities to prepare and present clinical material and by offering and defending expert opinion and advice. • Contribute to the preparation and adoption of clinical protocols and clinical guidelines and analyse the impact on clinical practice. <p>5. Perform systematic clinical audit to critically evaluate the performance and suitability of investigations offered, share the outcome of each audit and where appropriate justify a modification to practice based on the audit findings</p> <ul style="list-style-type: none"> • Initiate, perform and communicate the outcomes of clinical audits of the effectiveness of routine and non-routine clinical investigations considering national and local audit priorities and in accordance with the governance regulations. • Identify, critically evaluate and communicate the outcomes of clinical audits performed by others in relevant areas of clinical practice and justify a decision to adapt practice as appropriate. • In partnership with service users devise, develop, perform and critically evaluate clinical audits in own area of expertise to identify areas of good practice and areas for improvement. • Analyse and report the outcomes of clinical audits, including learning points and modifications introduced as a result of the clinical audit. 	<p></p> <p>1.3.1 1.3.2 3.1.14 3.1.16 3.2.4</p> <p>1.1.11 2.2.2 3.1.17</p>
Attitudes and Behaviours	<p>By the end of the training period HSS Trainees would be expected to demonstrate the attitudes and behaviours necessary for the role of a Consultant Clinical Scientist and will be able to:</p> <p>1. Commit to and provide leadership in the provision of high standards of clinical practice taking account of the political, social, technical, economic, organisational and professional environment and act as a positive role model</p> <ul style="list-style-type: none"> • Perform role to high standards of clinical practice applying knowledge and evidence, making decisions and evaluating the impact of those decisions. • Monitor, evaluate and maintain clinical practice standards. • Share data on clinical practice standards with service users and managers to encourage dialogue and debate. <p>2. Evaluate and use new research findings and new technology to plan, develop and deliver improved clinical investigations</p> <ul style="list-style-type: none"> • Analyse and use research findings and new technology in bringing about quality improvements in clinical investigation. • Use and critically review a range of sources of information to keep up to date with clinical and scientific developments in area of expertise. • Share ideas on improvements to clinical investigations with peers and service users setting out the context for change and 	<p>3.1.1 3.1.2 3.1.3 3.1.14</p> <p>3.1.5 3.1.6 3.1.9</p>

Topic	Clinical Practice	GSP Reference
	<p>evaluating the impact of any resulting change.</p> <p>3. Engage in two-way clinical liaison between those who request and those who provide clinical investigations for individual patients using the skills of team members effectively</p> <ul style="list-style-type: none"> • Lead and promote a culture of interaction with service users and patients. • Analyse, critically review, generate and revise clinical protocols and guidelines and evaluate how protocols and guidelines contribute to standards of clinical practice. • Train and empower colleagues to participate in two-way clinical liaison. • Initiate and audit of effectiveness of clinical liaison identifying areas for improvement and collaborating with colleagues to bring about change. <p>4. Promote the importance of active participation by Clinical Scientists in multidisciplinary clinical team meetings to advise and provide a scientific perspective</p> <ul style="list-style-type: none"> • Recognise the importance of the multidisciplinary clinical team and takes responsibility for ensuring appropriate and effective decision making processes are in place. • Support and contribute to the development of multidisciplinary clinical team working and work with the team to determine scientific service priorities. <p>5. Advocate clinical audit as a tool to evaluate and optimise clinical services and communicate ideas and aspirations</p> <ul style="list-style-type: none"> • Support the role of clinical audit as a valid tool to improve clinical effectiveness and patient care. • Commit to training of self and others to enable clinical audit to proceed. • Share the outcomes (both positive and negative) of clinical audits with service users and peers_having regard to clinical governance consequences. 	<p>1.3.1 3.1.4 3.1.12 3.1.13 3.1.14 3.2.4</p> <p>1.3.2 3.1.16</p> <p>1.1.11 1.3.6 2.2.2 3.1.17</p>

Topic	Research, Development and Innovation	GSP Reference
	<p>3. Critically appraise the results of a research and development project, draw conclusions in the correct clinical context and where appropriate, use them to plan follow up research and development</p> <ul style="list-style-type: none"> • Critically appraise the literature review, determine that the conclusions drawn the evidence supports the hypothesis to be tested. • Evaluate the research plan and its ability to confirm or refute the hypothesis, address the ethical issues and the extent to which patients/service users /experts have been involved in the design of the study. • Evaluate criteria/metrics for assessing and grading research data and publications in the Scientific, NHS and HE Sectors. • Summarise and apply the criteria for assessing diagnostic accuracy (e.g. STARD). • Critique methods of capturing and storing data relevant to research programme including the ethical issues relating to access and use of information. • Compare and contrast the range of formats and modes of presentation of data and defend the methods selected. • Apply relevant methods and techniques to analyse results ensuring the integrity of the data • Critically appraise the data analysis strategy including power calculations and apply relevant statistical methods seeking advice from experts when needed and recognising the • Defend personal role and responsibilities in respect of interpretation and analysis of research results and levels of authority in respect of interpretation and analysis of research results <p>4. Appraise the ways in which research and development findings can be disseminated amongst the scientific community including peers and other stakeholders in interested parties</p> <ul style="list-style-type: none"> • Compare and contrast methods of presenting research (written and oral) identify the strengths of each method with respect to the target audience. • Identify and if necessary seek expert advice with respect to potential Intellectual property issues that did not arise in the planning stage and implications for publishing. • Summarise the requirements for publications submitted to scientific, education and similar journals including the current conventions in respect of bibliography and referencing of information, and the implications of open access publishing. <p>5. Appraise and justify the process of translating research findings into service in the interests of patient care</p> <ul style="list-style-type: none"> • Identify the likely impact of research and on innovation in service design, delivery and clinical effectiveness including reverse innovation i.e. stopping doing something that no longer adds value. • With respect to pilot and field studies identify possible risks, evaluate methods and techniques and predict the expected outcomes ensuring compliance with the relevant ethical codes and regulatory requirements. • Identify and evaluate sources of expert advice. • Appraise own role and responsibilities within the testing process and clearly define the levels of authority and decision making within the testing process. • Describe methods of cost-benefit and cost effectiveness analysis and how they can be applied to aid decision making with respect to introducing research findings or innovation into service. • Summarise the relevance of Research Governance Framework to translating research or adopting and diffusion of innovation into practice 	<p>2.1.6 3.1.12 3.1.13 3.1.14 4.1.5 4.1.6 4.1.7</p> <p>3.1.16 4.1.9 4.1.10</p> <p>4.1.5 4.1.10</p>

Topic	Research, Development and Innovation	GSP Reference
Practical Skills	<p>By the end of the training period HSS Trainees would be expected to apply in practice a range of clinical skills and critically reflect on their performance and will be able to:</p> <ol style="list-style-type: none"> 1. Create the initial new idea, approach, technique and plan a research and development or innovation project critically evaluating the research proposal and drawing on expert advice where necessary and involving patients and service users <ul style="list-style-type: none"> • Search for and critically appraise relevant publications in the scientific literature relating ideas to current thinking, knowledge and research. • Identify the potential for innovation in service design and delivery to enhance clinical effectiveness. • Evaluate objectively and critically the feasibility and implications of investigation of the ideas and assessing the potential output, utility and impact of future study. • Identify potential intellectual property (IP) associated with the ideas and the steps to be taken to register IP. • Develop and maintain networks and identify potential collaborators and competition. • Clearly define and prioritise the aims and objectives of the research. • Specify the detailed components and proposed outputs of the research. • Identify methods, tools, techniques and approaches which are capable of achieving the required outcomes. • Establish evaluation criteria and methods. • Identify criteria and issues affecting funding sources at a level of detail sufficient to aid decision making. • Access relevant expert advice regarding sources of funding. • Target appropriate sources of funding for research and innovation. • Incorporate compliance with relevant ethical and regulatory requirements. • Prepare and present the plan to all relevant people, in the appropriate format and by the designated deadline. 2. Conduct and/or supervise a research and development or innovation project <ul style="list-style-type: none"> • Manage relationships with stakeholders and those involved to maximise effectiveness of the research programme. • Provide clear strategic direction and motivation to those involved in the research programme. • Ensure that all members of the research team understand their role and responsibilities including lines of communication and reporting, and that appropriate training is provided. • Specify clearly the levels of authority and decision making within the research programme. • Ensure availability of, and access to technical and administrative support at the appropriate level of expertise. • Conduct investigations in line with research plan. • Document investigations and results to comply with good research practice and good clinical practice. • Document and report fully any unexpected outcomes of incidents and modify investigation accordingly. • Report any delays or problems experienced to all interested parties, giving full explanation. • Pay proper attention to adverse events arising from investigations and take appropriate action to minimise risks. • Provide clear and timely guidance to deal with contingencies and factors influencing progress of the research programme. • Ensure compliance with Research Governance Framework, including continuous review and quality assurance of the research and development programme and adherence to the data archive process and requirement to provide access to the data for regulatory inspections. 	<p>1.1.4 1.1.5 1.3.1 3.1.7 4.1.1 4.1.2 4.1.3</p> <p>1.3.1 4.1.3 4.1.4 4.1.5 4.1.8</p>

Topic	Research, Development and Innovation	GSP Reference
	<p>3. Critically appraise the results of a research and development project, draw conclusions in the correct clinical context, and, where appropriate, use them to plan follow up research and development</p> <ul style="list-style-type: none"> • Select type and range of data to be collected in line with research plan, including primary and secondary sources. • Ensure that records comply with relevant legal, ethical and organisational requirements. • Ensure that records of research data are complete and accurate. • Assess the research information collected for its validity and reliability. • Select techniques of analysis and evaluation which are valid, reliable and appropriate to the research design and purpose. • Collate, record and analyse information accurately to produce justifiable results. • Verify the analysis using accepted and valid techniques including statistical tests. • Assess the results of research against the original objectives. • Assess the clinical significance and impact of the research. • Investigate reasons where the research has failed to achieve its objectives and provide clear explanation. • Draw conclusions drawn from results and explain the rationale for those conclusions. <p>4. Report and communicate research, development or innovation to peers and other interested parties including patients and service users</p> <ul style="list-style-type: none"> • Report and endeavour to publish all research, including negative findings. • Define the key purpose and objectives of the research programme and match results to these objectives. • Produce findings in format appropriate to purpose, and in line with relevant legal, ethical and organisational requirements. • Record accurately issues of copyright, declaration of interest and intellectual property rights. • Present findings in a format, language and style suitable for the target audience. • Include all relevant bibliographic references in line with current conventions. • Make a clear distinction between the results and the interpretation placed upon them. • Support the presentation with sufficient information to clarify key points. • Support presentation conclusions with reasoned argument and sufficient evidence. • Make recommendations, which are realistic, relevant and clearly defined. • Acknowledge collaborators, contributors and funding sources. • Effectively respond to questions and critical comments. • Observe time limitations for oral presentations and deadlines for written presentations. <p>5. Translate research findings or innovation solutions into service and provide examples of where this has been achieved</p> <ul style="list-style-type: none"> • Realign research findings or innovative approaches to create a service development or change plan • Assess impact of research on innovation in service design and delivery • Complete pilot and field studies in line with plan • Identify and report potential risks associated with the conduct of pilot and field studies • Maintain records of all pilot and field studies in accordance with the plan • Present documentation and provide verbal feedback as required by the plan 	<p>4.1.5 4.1.6 4.1.7 4.1.10</p> <p>4.1.9 4.1.10</p> <p>4.1.5 4.1.10</p>

Topic	Research, Development and Innovation	GSP Reference
	<ul style="list-style-type: none"> • Document and report any unexpected outcomes or incidents • Report any delays or problems experienced to authorised personnel with relevant degree of urgency. • Report on cost-benefit analysis of implementation. 	
Attitudes and Behaviours	<p>By the end of the training period HSS Trainees would be expected to demonstrate the attitudes and behaviours necessary for the role of a Consultant Clinical Scientist and will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate current debates and information and identify opportunities for research, development and innovation identifying and solving problems. <ul style="list-style-type: none"> • Appreciate the impact of current clinical outcomes on patients and carers in research area. • Accept the need to mitigate factors that limit current clinical outcomes and patient experience in research area. • Explore areas of clinical practice where significant improvements could contribute to better clinical outcomes and/or patient experience. • Recognise the opportunities for innovation in service design and/or delivery. • Use examples from the literature and own experience where research, development and innovation has contributed to better clinical outcomes and/or patient experience. 2. Apply rigorous standards to the conduct of research, development and innovation <ul style="list-style-type: none"> • Adhere to, and accept and work within current research ethics and research governance requirements applicable within organisation raising concerns when necessary. • Promote methods for defining and demonstrating compliance with relevant research ethics and research governance requirements. • Adhere to and accept methods for external assessment of compliance with research ethics and research governance requirements and learn from the process. • Critically reflect on and use examples of problems encountered by others when compliance with research ethics and research governance requirements was inadequate and apply learning to all aspects of research, development and innovation. 3. Commit to and lead collaborative research in the interests of improving clinical outcomes and/or patient experience <ul style="list-style-type: none"> • Accept and value the knowledge and experience that each research collaborator can bring to the planning, implementation and evaluation of a research project listening to, and evaluating the views of others. • Promote the importance of the multidisciplinary clinical team in setting practice standards and in auditing outcome against those standards. • Identify and promote the benefits to own specialism by being a partner in collaborative research. • Leadership to give examples of good clinical practice deriving from a collaborative approach to research and development. 4. Commit to sharing and disseminating research findings and the outcome and learning from innovation projects with peers <ul style="list-style-type: none"> • Accept the benefits and constraints of patents and confidentiality in research outcomes and innovation opportunities. • Collaborate with a group of peers with an interest in improving clinical outcomes and/or patient experience in the same area of research to create opportunities for research, development and innovation. 	<p>4.1.1 4.1.2</p> <p>4.1.4</p> <p>4.1.3 4.1.10</p> <p>4.1.6 4.1.7 4.1.9</p>

Topic	Research, Development and Innovation	GSP Reference
	<ul style="list-style-type: none"> • Facilitate peer discussions on the value of current research and the opportunities for new research, be open to challenge and revise views in response to discussion when necessary. • Promote opportunities to present research findings to peers and critically appraise the research findings of others. <p>5. Actively seek opportunities to translate research findings and the diffusion and adoption of innovation into clinical practice</p> <ul style="list-style-type: none"> • Challenge and influence to mitigate current barriers to the translation of research findings or new innovative ways of working into clinical practice across the organisation and, where appropriate, nationally. • Promote opportunities to undertake targeted translational research and innovation encouraging the contribution of the healthcare team. • Identify examples of where the translation of research findings into practice has resulted in improved clinical outcomes and/or patient experience to influence the translation, adoption and diffusion of new findings, negotiating, questioning and challenging where necessary. • Promote the importance of innovation in service design and/or delivery including the contribution of research and innovation in healthcare to business and the UK economy. • Engage service users, patients and the public to promote the positive impact of research and innovation on clinical outcomes and/or patient experience. 	<p>4.1.9 4.1.10</p>

Domain 5: Clinical Leadership

Topic	Clinical Leadership	GSP Reference
Learning Objective	By the end of this stage of training, HSS Trainees will be able to critically appraise the evidence base underpinning clinical leadership frameworks and operate as a clinical leader involved in the planning, delivery and transformation of health and social care services.	
Knowledge	<p>By the end of the training period HSS Trainees will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate the personal qualities required of a clinical leader and critically reflect on performance to identify his/her own personal qualities, including values, principles and assumptions developing action plans to adapt personal behaviour as necessary <ul style="list-style-type: none"> • Critically appraise models of leadership including the shared or distributed model for organisations where tasks are more complex and highly interdependent. • Evaluate a range of tools that enable exploration of the ways in which individual behaviours impact on others. • Evaluate a range of feedback models to obtain and respond to feedback from others. • Review and justify the use of a range of tools and techniques for managing stress including occupational health and other support networks. • The importance of best practice, transparency and consistency. • Summarises the professional, legal and ethical codes of the Health and Care Professions Council and other relevant bodies. • Evaluate a range of tools to identify personal preferences and prejudices and those within others, society and cultures. 2. Evaluate the importance of working with others in teams and networks to deliver and improve services <ul style="list-style-type: none"> • Discuss the role of team dynamics in the way a group, team or department functions. • Evaluate a range of team structures and the structure, roles and responsibilities of the multidisciplinary teams within the broader health context relevant to the specialism, including other agencies and the impact of different structures on the delivery of care. • Critique a range of techniques and methods that facilitate effective and empathic communication and the evidence base underpinning them • Evaluate a range of models to facilitate conflict resolution • Critically explore a range of leadership styles and approaches and identify the applicability, strengths and weakness of each to different situations and people 3. Critically evaluate methods by which services may be planned and people and resources managed effectively <ul style="list-style-type: none"> • Summarise the structure, financing and operation of the NHS and its constituent organisations and compare this to other systems of healthcare. • Ethical and equality aspects relating to management and leadership e.g. approaches to use of resources/rationing; approaches to involving services users in decision making. • Discuss business management principles: priority setting and basic understanding of how to produce a business plan. • Identify the requirements of running a department, unit or practice relevant to the specialism. • Justify the allocation of funding to scientific services and evaluate how clinical resources to provide high quality care should 	<p>1.1.2 1.1.3 1.1.5 1.1.6 1.1.7 5.1.1</p> <p>1.3.1 1.3.2 1.3.5 5.1.2 5.1.4 5.1.5 5.1.7</p> <p>5.1.1 5.1.6</p>

Topic	Clinical Leadership	GSP Reference
	<p>be allocated considering the financial constraints of the NHS and local organisations.</p> <ul style="list-style-type: none"> • Summarise the commissioning, funding and contracting arrangements relevant to the specialism including education, training and continuing professional development. • Critique relevant legislation (e.g. Equality and Diversity, Health & Safety, Employment Law) and local Human Resources policies and the impact of these policies on people and the organisation. • Discuss the duties rights and responsibilities of an employer, and of a co-worker. • Justify the role of individual performance review considering its purpose, techniques and processes, including the difference between appraisal, assessment and revalidation. • Compare and contrast methods to measure and manage the performance of the organisation. • Analyse the source of complaints, and review and reflect on how complaints are managed and the learning that is fed back into the organisation to improve the patient and staff experience. <p>4. Critically evaluate how clinical leadership can support the delivery of high quality services and by service improvements and the methods by which it may be achieved delivering high quality services and by developing improvements to service.</p> <ul style="list-style-type: none"> • Evaluate risk management issues pertinent to the area of practice and wider organisation identifying potential sources of risk and risk management tools, techniques and protocols. • Summarise how healthcare governance influences patient care, research, innovation and educational activities at local regional and national level. • Summarise key government reports on maintaining professional standards and discuss the mechanism for raising issues where you consider that standards are being compromised ('whistleblowing'). • Appraise quality improvement methodologies including a range of methods obtaining feedback from users, staff, patients and the public and explore the impact on patients, services and the organisation. • Discuss the principles and processes of evaluation, audit, research, and development, innovation, clinical guidelines and standard setting in improving quality and identify barriers to the adoption and success of each measure in practice. • Identify a variety of methodologies for developing creative solutions to improving services. • Explore the implications of change on systems and people and methods to minimise the negative effects of change including strategies for motivating people to change, the effect of organisational culture. • Describe project management methodology and how it can be used during change. <p>5. Justify the importance of strategic planning in line with the aspirations of the organisation</p> <ul style="list-style-type: none"> • Summarise the responsibilities of the various Executive Board members and Clinical Directors or leaders. • Summarise the functions and responsibilities of national bodies such as department of Health, Care Quality Commission, NHS Evidence, National Patient Safety Agency, Medicines and Healthcare products Regulatory Agency, Royal Colleges and faculties, specialty organisations, representative bodies, regulatory bodies, educational and training organisations. • Analyse patient outcome reporting systems within the specialism, and the organisation and how these relate to national programmes. • Summarise how research, development and innovation contribute to strategic planning. • Critically review the decision making for individuals, teams and the organisation and the impact on service delivery and patient 	<p>1.1.12 2.2.2 2.3.2 2.3.2 2.3.3 2.3.4 3.1.17 5.1.8 5.1.10 5.1.11</p> <p>1.3.1 1.3.3 5.1.1 5.1.6 5.1.12</p>

Topic	Clinical Leadership	GSP Reference
	<p>care.</p> <ul style="list-style-type: none"> • Compare and contrast a range of communication strategies and identify the factors that promote effective communication strategies within organisations. • Explore methods of undertaking impact mapping of service change and how this can support the process of change. • Identify barriers to change and how to develop strategies to explore and break down barriers. • Summarise qualitative methods to gather and analyse the experience of users, patients and carers and utilise the data to recognise areas of good practice/planning and help shape the planning process. 	
Practical Skills	<p>By the end of the training period HSS Trainees would be expected to apply in practice a range of clinical skills and critically reflect on their performance and will be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate through personal example his/her own personal qualities, including values, principles and assumptions and critically reflect on personal performance and: <ul style="list-style-type: none"> • Maintain and routinely practice critical self awareness, including ability to discuss strengths and weaknesses with supervisor, recognising external influences and changing behaviour accordingly. • Show awareness and sensitivity to the way in which cultural and religious beliefs affect approaches and decisions, and to respond effectively. • Recognise the manifestations of stress on self and others and know where and when to look for support. • Balance personal and professional roles and responsibilities, prioritising tasks and having realistic expectations of what can be completed by self and others. • Use a reflective approach to practice with an ability to learn from previous experience. • Use assessment, appraisal, complaints and other feedback to discuss and develop an understanding of own development needs. • Recognise, analyse and know how to deal with unprofessional behaviours in clinical practice taking into account local and national regulations. • Create open and non-discriminatory professional working relationships with colleagues, including awareness of the need to promote equality of opportunity and to prevent bullying and harassment in the workplace. 2. Work with others in teams and networks to deliver and improve services <ul style="list-style-type: none"> • Work in differing and complementary roles within the different communities of practice within which they work. • Support bringing together different professionals, disciplines, and other agencies, to provide high quality healthcare. • Develop effective working relationships with colleagues and other staff through good communication skills; building rapport and articulating own view. • Communicate effectively in the resolution of conflicts, providing feedback, and identifying and rectifying team dysfunction. • Facilitate, chair and contribute to meetings within the department, the organisation, national societies/professional bodies. • Encourage staff to develop and exercise their own leadership skills. • Enable individuals, groups and agencies to implement plans and decisions. • Identify and prioritise tasks and responsibilities including to delegate and supervise safely. 	<p>1.1.12 1.2.3 5.1.1 5.1.2 5.1.3 5.1.4 5.1.12</p> <p>1.3.4 1.3.5 1.3.6 5.1.1 5.1.2 5.1.3 5.1.4 5.1.10</p>

Topic	Clinical Leadership	GSP Reference
	<p>3. Effectively management of services using critical reflection to evaluate and improve personal performance</p> <ul style="list-style-type: none"> • Develop and implement protocols and guidelines. • Analyse feedback and comments and integrate them into plans for the service. • Use clinical audit with the purpose of highlighting resources required. • Manage time and resources effectively in terms of delivering services to patients. • Prepare rotas, delegate, organise and lead teams. • Contribute to the recruitment and selection of staff. • Contribute to staff development and training, including mentoring, supervision and appraisal. • Use and adhere to clinical guidelines and protocols, relevant reporting systems and complaints management systems. • Improve services following evaluation/performance management. <p>4. Contribute to continuous service improvement developing improvements to service and reflecting on experience to ensure the delivery of high quality services</p> <ul style="list-style-type: none"> • Report clinical incidents in accordance with reporting procedures. • Assess and analyse situations, services and facilities implementing recommendations in order to minimise risk to patients and the public. • Monitor the quality of equipment and safety of environment relevant to the specialism acting swiftly to resolve issues. • Design and undertake an audit project, present the results and develop an implementation and re-evaluation plan as appropriate to the audit. • Contribute to meetings which cover audit; critical incident reporting; patient outcomes challenges, justifying, influencing as appropriate. • Question and challenge existing practice in order to improve services. • Apply creative thinking approaches (or methodologies or techniques) in order to propose solutions to service issues. • Provide clinical expertise in evolving situations. • Present written and verbal information in a clear, concise way using language appropriate to the audience. <p>5. Contribute to and undertake strategic planning in line with the aspirations of the organisation and its impact on service quality and delivery</p> <ul style="list-style-type: none"> • Discuss the local, national and UK health priorities and how they impact on the delivery of healthcare relevant to the specialism • Identify trends, future options and strategy relevant to the specialism and delivering patient services • Compare and benchmark healthcare services • Use a broad range of scientific and policy publications relating to delivering healthcare services • Prepare for meetings – reading agendas, understanding minutes, action points and background research on agenda items. • Work collegiately and collaboratively with a wide range of people outside the immediate clinical setting. • Evaluate outcomes and re-assess the solutions through research, audit and quality assurance activities. • Evaluate the wider impact of implementing change in healthcare provision and the potential for opportunity costs. 	<p>1.4.1-1.4.6 5.1.5 5.1.6 5.1.8 5.1.9 5.1.10 5.1.11</p> <p>1.1.11 1.4.4 1.4.5 1.4.6 5.1.3 5.1.7 5.1.8</p> <p>5.1.1 5.1.12</p>

Topic	Clinical Leadership	GSP Reference
Attitudes and Behaviours	<p>By the end of the training period HSS Trainees would be expected to demonstrate the attitudes and behaviours necessary for the role of a Consultant Clinical Scientist and will be able to:</p> <ol style="list-style-type: none"> 1. Consistently operate within sphere of personal capability and level of authority, managing personal workload and objectives to achieve quality of care. <ul style="list-style-type: none"> • Adopt a patient focussed approach to decisions that acknowledges the right, values and strengths of patients and the public. • Comply with relevant legislation to recognise and show respect for diversity and differences in others. • Be conscientious, able to manage time and delegate responsibly. • Recognise personal health as an important issue in maintaining personal capability. • Accept responsibility for own actions. • Commit to continuing professional development, which involves seeking training and self-development opportunities, learning from colleagues and accepting constructive criticism. • Accept professional regulation and ensure compliance with relevant standards. • Promote appropriate professional attitudes and values. • Act with probity and be willing to be truthful and admit and learn from errors. 2. Actively seek to encourage and work within a team environment, including multidisciplinary teams <ul style="list-style-type: none"> • Interact effectively with professionals in other disciplines and agencies • Respect the skills and contributions of colleagues • Recognise good advice and continuously promote value-based non-prejudicial practice. • Use authority appropriately and assertively being willing to follow when necessary. • Use authority sensitively and assertively to resolve conflict and disagreement. • Take full part in multidisciplinary meetings. • Show recognition of a team approach and willingness to consult and work as part of a team • Respect colleagues and other healthcare professionals. 3. Manage resources effectively in the interests of improving patient services promoting equity in healthcare access and delivery <ul style="list-style-type: none"> • Use public money appropriately and to taking action when resources are not used efficiently or effectively. • Recognise that in addition to patient specific clinical records, clinical staff also have responsibilities for other records (e.g. research). • Supervise the work of less experienced colleagues supporting them to develop. • Use communication skills and inspire confidence and trust. • Respond constructively to the outcome of reviews, assessments or appraisals of performance • Recognise the needs of all staff in the clinical team. 4. Engage in continuous service improvement in the interests of better patient outcomes <ul style="list-style-type: none"> • Actively seek advice/assistance whenever concerns about patient safety arise. • Take responsibility for clinical governance activities, risk management and audit in order to improve the quality of the service. 	<p>1.1.3 1.1.4 1.1.6 5.1.1</p> <p>1.3.1 1.3.2</p> <p>1.3.1 1.3.5 5.1.2 5.1.6 5.1.11</p> <p>1.1.12 1.2.2 3.1.17</p>

Topic	Clinical Leadership	GSP Reference
	<ul style="list-style-type: none"> • Listen to and reflect on the views of users, patients and carers, dealing with complaints in a sensitive and co-operative manner. • Act as an advocate for the service. • Be open minded to new ideas. • Adopt a proactive approach to new technologies and treatments. • Support colleagues to voice ideas. • Be positive about improvement and change. • Strive for continuing improvement in delivering patient care services. <p>5. Contribute to articulating the aspirations of the organisation and be willing to align strategic planning with these aspirations to improve service quality and delivery.</p> <ul style="list-style-type: none"> • Comply with national guidelines that influence healthcare provision. • Articulate ideas and use effective influencing skills. • Identify and reflect on issues and potential solutions before acting. • Appreciate the importance of involving service users, the public and communities in developing health services. • Participate in decision making processes beyond the immediate clinical care setting. • Implement proven improvements in clinical practice and services. • Obtain and analyse the evidence base before declaring effectiveness of changes. • Support the dissemination of good practice. 	<p>5.1.6 5.1.7 5.1.8 5.1.10 5.1.11</p> <p>5.1.10 5.1.11 5.1.12</p>

Specialty-specific clinical biochemistry curriculum

Stage 1 (12 months)

Module of curriculum: Module 1 (*This module to be examined in FRCPath Part 1 examination*)

Module 1a Health and safety in clinical biochemistry practice

Topic	Module 1a Health and safety in clinical biochemistry practice	Assessment methods	GSP reference
Learning objectives	<p>By the end of the training period trainees will, with respect to health and safety issues both locally and nationally in order to practise safely in a laboratory, clinical or other settings and advise on safe practice be able to</p> <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. <p>Trainees will also be expected to perform risk assessments and develop, refine and evaluate health and safety precautions relating to patient management</p>		
Knowledge 1. Health and safety legislation and guidance 2. ACDP categorisation of biological agents 3. Laboratory safety and containment 4. Transport regulations	<p>By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to the:</p> <ul style="list-style-type: none"> • Health and Safety at Work Act (1974) • Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) • Control of Substances Hazardous to Health (COSHH) Regulations (2002) • Genetically Modified Organisms (Contained Use) Regulations (2001) • Management of Health and Safety at Work Regulations (1999) • Transport of Infectious Substances (2011) guidance • The management, design and operation of microbiological containment laboratories (2001) guidance (HSE) • Biological agents: Managing the risks in laboratories and healthcare premises (HSE) • Safe disposal of clinical waste (1999) guidance. 	FRCPath Part 1 WPBA	1, 2
Technical skills and procedures	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • aseptic technique. 	WPBA	2, 3
Clinical skills			3

Module 1b: Laboratory competences: Analytical techniques and instrumentation

Topic	Module 1b Laboratory competences: Analytical techniques and instrumentation	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of the clinical biochemistry laboratory and its clinical interface, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the methods of standardisation and calibration • common method interferences • the use of pipettes • preparation and storage of reagents • use of centrifuges • maintenance of centrifuges • mechanisms of common interferences in laboratory assays • heterophilic antibodies, how they interfere in assays, and how the interference can be detected and eliminated • automated instruments including their layout, robotics and modules • the principles of spectrophotometric methods • the applications of spectrophotometry and turbidimetry • the principle of osmometry • the principle of electrometric methods • how ion selective electrodes work and how they are used in clinical applications • the principles of enzymology • the advantages and disadvantages of different measurement methods involving enzymes • the use of enzymes as reagents • the principles of immunochemical techniques • the advantages and disadvantages of competitive binding and immunometric assays • the labels available in immunoassays and the instrumentation applicable to each • the principles of electrophoresis • the principles of chromatography • the principles, advantages and disadvantages of point-of-care testing • the types of point-of-care devices available • the principles of solid/dry phase chemistry • the advantages and disadvantages of these methods • clinical applications of these methods. 	FRCPath Part 1 WPBA	2

<p>Technical skills and procedures</p>	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • the performance of methods used in clinical biochemistry • results of investigations into sources of error • spectrophotometric method • osmometry assay • electrometric method • enzymology method • immunochemical assay • serum electrophoresis • chromatographic technique • point-of-care assay • the limitations of widely used methods in clinical biochemistry • sources of error • setting up and running of an assay • possible assay interference. 	<p>WPBA</p>	<p>2</p>
<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the clinical biochemistry laboratory and its clinical interface, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • methods for the measurement of analytes. 	<p>WPBA</p>	<p>2</p>

Module 1c: Laboratory competences: Evaluation of an analytical method

Topic	Module 1c Laboratory competences: Evaluation of an analytical method	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of the clinical biochemistry laboratory and its clinical interface, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the criteria for a practicable assay • the steps in optimising reaction conditions • how to identify critical parameters that affect robustness of assays • bias, imprecision, sensitivity and specificity • how to investigate common interferences • how to define the applicable range of an assay • criteria for acceptability. 	FRCPATH Part 1 WPBA	2
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • plan how to establish and validate a new method • write a standard operating procedure for the new method. 	WPBA	2
Clinical skills			

Module 1d: Clinical governance and audit competences

Topic	Module 1d Clinical governance and audit competences	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of accountability, quality improvement programmes, clinical audit, evidence-based practice, clinical standards and guidelines, managing risk and quality assurance programmes, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the principles of clinical governance • how to set up investigative protocols • how to judge service quality • what accountability means • how risk assessment is carried out • writing a report on an adverse event • recalling a protocol for investigating a common condition • how to analyse data for turnaround time • how to analyse a complaint • the concept of systematic reviews • the audit cycle • recalling an instance of a clinical audit in which you participated • the principles of clinical governance, clinical risk management • departmental organisation • the principles of development and assessment of service quality • the principles of clinical audit • clinical effectiveness and audit including the concept of systematic reviews and evidence-based medicine, the role of audit in the hospital, and the audit cycle • participation in regular clinical audit, within and between departments, at the interface with primary care and at regional level. 	FRCPath Part 1 WPBA	1, 2, 5
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the roles, responsibility and accountability in your laboratory • how a risk that was identified in your laboratory was managed • how risk assessment is undertaken. • lines of responsibility and accountability in laboratory medicine 	WPBA	1, 2, 5

	<ul style="list-style-type: none"> • communications within and outside the department • how to monitor/report adverse events • present a report about an adverse event that occurred in your laboratory • turnaround time and describe how to measure it • analysis of a complaint with lessons learnt and action taken • present a summary of an audit that you have undertaken and how the audit cycle was/could have been closed • an instance of a clinical audit in which you participated • how workload can be compared with national standards • agreed protocols for investigations of common conditions. • how to measure turnaround time • how out-of-hours service should be provided • clinical effectiveness, the role of clinical audit in achieving this, and methods of clinical audit in healthcare. • an audit at multidisciplinary audit meetings and the follow up • how audit is used to gather evidence provided by formal review of practices and clinical performance and ensure that quality requirements and the needs of governance are being met • participation in regular clinical audit, within and between departments, at the interface with primary care and at regional level. 		
Clinical skills			

Module 1e: Competencies in the clinical biochemistry of disease

Topic	Module 1e Competencies in the clinical biochemistry of disease	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of understanding of normal human biochemistry and physiology to the clinical biochemistry of screening, diagnosis and monitoring of disease, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the biochemical, haematological and imaging techniques that are available for diagnosis and screening, with examples of their use and a discussion of their advantages and disadvantages • how therapeutic agents act • the place of molecular biology techniques in diagnosis • how biological variation affects reference intervals. 	FRCPATH Part 1 WPBA	2, 4
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • how laboratory investigations are used to diagnose, to monitor disease progression, and follow treatment • the process of communication with colleagues and other clinical teams, with examples of a conversation with a primary or secondary care clinical team • the influence of factors such as environment on biochemical results. 	WPBA	1, 2, 3
Clinical skills			

Module 1f: Competencies in the interpretation of laboratory data

Topic	Module 1f Competencies in the interpretation of laboratory data	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the interpretation of laboratory data, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • how understanding physiological changes helps to interpret laboratory data. 	FRCPATH Part 1 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • giving examples of appropriate comments. 	WPBA	2
Clinical skills	By the end of the training period the trainee will be able to perform, adapt and master the clinical skills necessary to: <ul style="list-style-type: none"> • recall an example of a contribution to a ward round or a case discussion • describe the role of the duty biochemist • recall an example of following up abnormal investigations. 	WPBA MSF	1, 3

Module of curriculum: Module 2 LABORATORY COMPETENCES

(This module to be examined in FRCPath Part 1 examination)

Module 2a: Laboratory competencies: Introduction to clinical biochemistry

Topic	Module 2a Laboratory competencies: Introduction to clinical biochemistry	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of laboratory competencies, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • how automated analysers work • how specimens are obtained, handled, transported, and stored • specimen preservatives and their effects on analysis • the principles of health and safety • the purpose of IT in the laboratory • the principles of data protection and the Data Protection Act • quality control and quality assurance • how common clinical conditions present. 	FRCPath Part 1 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the principles behind automated analysers • a set of results • how to identify invalid results • the functions of pathology reception, the phlebotomy service • the problems associated with 24-hour urine collections • the main aspects of health and safety in the laboratory. • the legal obligations of the laboratory • the process of laboratory accreditation with reference to Clinical Pathology Accreditation (CPA) standards • the role of the Health and Safety Executive • the fundamental aspects of computing within the laboratory • the use of databases, spread sheets, internet in the laboratory 	WPBA	2, 3

	<ul style="list-style-type: none"> • a multidisciplinary clinical audit • quality control and quality assurance data, including external quality control reports • how external quality assurance organisations process data. • external quality assurance data to identify possible analytical problems • clinically important results, advise on the differential diagnosis, and discuss clinical management. 		
Clinical skills	<p>By the end of the training period trainees will, in respect of the laboratory competencies, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • liaison with clinical teams to identify clinically important results. 	WPBA	1, 3

Module 2b: Laboratory competencies: Analytical techniques and instrumentation

Topic	Module 2b Laboratory competencies: Analytical techniques and instrumentation	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of analytical techniques and instrumentation, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • methods of standardisation and calibration • how to identify common method interferences • use of pipettes • describe: <ul style="list-style-type: none"> - how to prepare and store reagents - use and maintenance of centrifuges • assay interference: <ul style="list-style-type: none"> - mechanisms by which common interferents affect laboratory assays (haemolysis, jaundice, lipaemia) • heterophilic antibodies • the principles of automated instrumentation, including random access, immunoassay analysers robotics and modular systems • the principles and practical aspects of spectrometric methods including <ul style="list-style-type: none"> - spectrometry: visible, UV, reflectance, bichromatic, derivative, linear diode array, infra-red - turbidimetry, nephelometry, densitometry, fluorimetry - nuclear magnetic resonance - mass spectrometry - flame emission spectrometry - atomic absorption: flame, furnace, inductively coupled plasma mass spectrometry (ICPMS) • the principles of osmometry • the principles of ion selective electrodes Na⁺, K⁺, Cl⁻, H⁺, pO₂, pCO₂, Ca²⁺, NH⁴⁺, Mg²⁺, Li⁺ • the principles of enzymology including fixed interval and kinetic assays, isoenzymes, and the use of enzymes as reagents • the principles of radioisotope counting including gamma- and beta-counting • how immunochemical techniques including immuno-assay, -metric assays, -electrophoresis, -fixation and -diffusion work 	FRCPATH Part 1 WPBA	2

	<ul style="list-style-type: none"> • the advantages of different labels in immunological techniques • the principles and methods of electrophoresis • methods for different chromatography techniques, including separation and detection methods • the technical principles of point-of-care analysers • the uses of solid/dry phase chemistry • DNA/RNA/chromosomal analyses including PCR and Southern blotting. 		
Technical skills and procedures	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • the use of common laboratory techniques • the performance and limitations of a method or technique commonly used in clinical biochemistry • how to detect errors and sources of error • analytical skills necessary in a laboratory • an experiment to investigate possible assay interference • the technology and design of biochemistry analysers and their limitations and benefits • the application of some spectrometric methods • how to use osmometry • write a report on a QA scheme • how to interpret mutation analysis and its application to diagnoses and family studies. 	WPBA	2
Clinical skills			

Module 2c: Laboratory competencies: Evaluation of an analytical method

Topic	Module 2c Laboratory competencies: Evaluation of an analytical method	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of the evaluation of an analytical method, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the practicability of, and criteria for accepting an assay • how to optimise reaction conditions, recognise critical parameters (robustness) • bias, imprecision, sensitivity, specificity • how to investigate for common interferences. 	FRCPATH Part 1 WPBA	2
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • how a new method was established and validated • the standard operating procedure of the method from your portfolio. 	WPBA MSF	2
Clinical skills			

Stage 2 (48 months)

Developing independent practice

Objective

Throughout their training, trainees are given increasing responsibility and independence appropriate for their demonstrated level of competence and professional development, as judged by their clinical and educational supervisors. The purpose of this stage of training is to take such graded responsibility further, to enable the transition to the independent practice required of an FRCPath holder.

Demonstration of the skills required for independent practice is a requirement of the curriculum, and the relevant competencies must be assessed and achieved prior to completion of the training programme.

Currently, the most appropriate context in which to train for and achieve the competencies for independent practice is out-of-hours working, in an 'on-call' setting. However, there may be practical alternatives to this training context. If a training programme does not offer the opportunity to develop and demonstrate these skills through out-of-hours working, there must be alternative arrangements agreed by the relevant individual overseeing training.

Since the trainee will have reduced supervision during this form of training, to ensure patient safety and to optimise the benefits of this training, the following criteria must be met before it starts:

- the trainee must have been assessed by clinical and educational supervisors to be capable of safe practice with reduced supervision in relevant areas of the curriculum. They must therefore be in full compliance with the educational processes of the Annual Progression Review, i.e. ready to start more independent practice.
- before starting this training, the trainee must have a formal induction to ensure that they are familiar with the aspects of the work to be performed. This induction must be relevant to the time at which the work is to be performed, and for the organisations for which it is to be performed. It will include relevant local policies.
- the supervisor must ensure that the trainee understands the professional obligations of this form of practice, including availability and confidentiality.
- the trainee must have demonstrated to clinical and educational supervisors through previous directly supervised practice, competence in managing common clinical and laboratory problems of the kind likely to be encountered in the clinical biochemistry service, relevant to the setting in which the trainee will undertake this form of practice.
- arrangements for 'handover' of clinical responsibility during this form of practice must be explicit.

Arrangements for cover by clinical supervisor

The ultimate responsibility for the quality of patient care and the quality of training lies with the supervisor. However, the trainee will be expected to exercise professional judgement in recognising the limits of their capabilities and in involving senior colleagues in complex or challenging issues/decisions. The arrangements for obtaining such help and advice, at any time during this training period, must be formal and explicit. Although the purpose of this training is to enable independent working, the trainee must not be discouraged from asking for help from a clinical supervisor during this period at any time.

After a period of independent practice, the trainee must be debriefed by the clinical supervisor. The purpose of this debrief is to ensure that patients are being managed safely, and that prompt feedback is provided on the trainee's performance against the relevance competencies for this form of training (see below) and other competencies in the curriculum. The debriefing session may take the form of 'handover' to colleagues.

Competencies to be demonstrated

Topic	Professional practice	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of achieving sufficient knowledge of professional practice to offer basic advice on the interpretation of results be able to: <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform, adapt and master a range of technical and clinical skills and procedures. Demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level.		
Knowledge Independent practice and working out of hours	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice with respect to <ul style="list-style-type: none"> increasing familiarity with laboratory and clinical aspects of clinical biochemistry know what must be dealt with urgently and what may be dealt with less urgently. 	FRCPATH Part 2	1, 2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> recognise and work within own limitations in knowledge liaise and communicate with a wide range of healthcare workers involved in relevant patient care communicate effectively in person and by telephone refer to more experienced colleagues as appropriate provide continuity of care prioritise work according to urgency deal with difficult situations independently recognise and analyse the overall effects of competing pressures on healthcare resources, e.g. availability of laboratory tests, availability of beds collect, analyse and interpret information from a variety of sources make safe decisions when clinical or laboratory information is incomplete or evolving work with clinical and laboratory colleagues under pressure. 	FRCPATH Part 2, WPBA, MSF	1, 2, 3
Clinical skills	By the end of the training period the trainee will be able to apply knowledge of developing independent practice to perform, adapt and master the clinical skills necessary to: <ul style="list-style-type: none"> demonstrate increasing familiarity with laboratory and clinical aspects of clinical biochemistry demonstrate knowledge of what must be dealt with urgently and what may be dealt with less urgently. 	FRCPATH Part 2, WPBA	1, 2, 3

Module of curriculum: Module 3 COMPETENCIES IN THE CLINICAL BIOCHEMISTRY OF DISEASE

(This module to be examined in FRCPATH Part 2 examination)

Module 3a: Competencies in the clinical biochemistry of disease: Generic aspects

Topic	Module 3a Competencies in the clinical biochemistry of disease: Generic aspects	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of disease, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the physiology, biochemistry, pathogenesis, pathophysiology natural history, epidemiology, presentation, diagnosis, causes, classification, and complications of disease • molecular biology, biochemical, haematological and radiological techniques required for investigation, diagnosis and screening • how knowledge of the pharmacology of therapeutic agents is required in clinical management. 	FRCPATH Part 2 WPBA	2
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • appropriate use and interpretation of the results of the laboratory investigations in screening for disease, to establish (differential) diagnosis, to monitor progress and treatment • liaison and communication with colleagues and other clinical teams in primary and secondary care both verbally and via letters. 	WPBA MSF	2, 3
Clinical skills			

Module 3b: Competencies in the clinical biochemistry of disease: Biological variability

Topic	Module 3b Competencies in the clinical biochemistry of disease: Biological variability	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of biological variability, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • reference values and population statistics taking into account inter- and intra-individual variation, and the effects of age and sex • the assessment and application of biological variance data in setting analytical goals. • how to assess utility of reference values • significance of changes in serial results. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the effect of genetic and environmental influences such as age, sex, nutrition, time of day, stress, posture, hospitalisation and therapeutic agents on biochemical results. 	WPBA MSF	2, 3
Clinical skills			

Module 3c: Competencies in the clinical biochemistry of disease: Gastrointestinal tract

Topic	Module 3c Competencies in the clinical biochemistry of disease: Gastrointestinal tract	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the gastrointestinal tract, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the physiology and biochemistry of digestion • the endocrine functions of the gut • the production and control of gastrointestinal hormones with examples of pathological conditions, such as peptic ulcer disease, pancreatic tumours • major pathological conditions of the gut, such as pyloric obstruction, malabsorption, pancreatitis, anaemia due to bowel disease, inflammatory bowel disease, intestinal failure, malignant tumours, including carcinoid syndrome and neuroendocrine tumours • investigation of gut function, including gut hormones, investigation of malabsorption • the principles and practical problems in faecal analysis. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures			
Clinical skills			

Module 3d: Competencies in the clinical biochemistry of disease: Liver

Topic	Module 3d Competencies in the clinical biochemistry of disease: Liver	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the liver, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the functions of the liver • formation of bilirubin, enterohepatic circulation and bile salts • the causes of jaundice • diseases of the liver, such as viral hepatitis, cirrhosis, haemochromatosis, Wilson's disease, alcohol/drug hepatotoxicity, non-alcoholic fatty liver disease, cholestasis, biliary obstruction, gall stones and their composition • the features of hepatic failure and encephalopathy • the assessment of hepatic function, using liver function tests, prothrombin time, ammonia. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures			
Clinical skills			

Module 3e: Competencies in the clinical biochemistry of disease: Urogenital tract

Topic	Module 3e Competencies in the clinical biochemistry of disease: Urogenital tract	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the urogenital tract, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • renal physiology and how it can be assessed, including glomerular and tubular function, salt and water homeostasis, hydrogen ion homeostasis, and renal production of hormones such as renin, erythropoietin, and vitamin D • the composition of urine • the features of renal disease, distinguish between pre and post-renal uraemia, acute and chronic renal disease • how stones are formed • renal tubular function, how renal tubular defects occur and the main features • how metabolic diseases may affect the kidney • how renal function may be assessed, including measurement and estimation of glomerular filtration rate, markers of renal function, tubular function tests, protein/creatinine ratios, and drug interference in urine analysis • different forms of renal replacement therapy, including dialysis, transplantation and markers of transplant rejection • prostatic diseases. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures			
Clinical skills			

Module 3f: Competencies in the clinical biochemistry of disease: Gas transport and H⁺ metabolism

Topic	Module 3f Competencies in the clinical biochemistry of disease: Gas transport and H ⁺ metabolism	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of gas transport and H ⁺ metabolism, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the physiology of normal respiration, O₂, CO₂, transport, buffers • respiratory and renal mechanisms in acid-base homeostasis • the causes and assessment of acid-base disturbances: measurement of H⁺ pCO₂, pO₂ • determinants and assessment of tissue oxygenation. Students' written evaluations of their practice should demonstrate new insights into the application of current theories of clinical biochemistry screening in normal or complex situations.	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures			
Clinical skills			

Module 3g: Competencies in the clinical biochemistry of disease: Water and electrolytes

Topic	Module 3g Competencies in the clinical biochemistry of disease: Water and electrolytes	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of water and electrolytes, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the distribution of water and electrolytes, and turnover of body fluids • the regulation of extracellular fluid, osmolality and volume, including the roles of antidiuretic hormone, renin-angiotensin-aldosterone, and natriuretic peptides • conditions in which water depletion and excess occur, including disorders of sodium and potassium, metabolic effects of trauma/surgery/stress, and principles of intravenous fluid therapy. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures			
Clinical skills			

Module 3h: Competencies in the clinical biochemistry of disease: Proteins

Topic	Module 3h Competencies in the clinical biochemistry of disease: Proteins	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of proteins, be able to: <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform a range of technical and clinical skills and procedures demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> the principles of measuring proteins properties and functions of the principal plasma proteins including albumin, protease inhibitors, transport proteins, caeruloplasmin, clotting factors, and immunoglobulins the acute phase response and how it affects different proteins. the causes, effects and investigations of hypoalbuminaemia, paraproteinaemias, proteins of inflammation, immunoglobulin deficiencies, alpha-1-antitrypsin and cytokines. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> the laboratory investigation of normality and disease. 	WPBA MSF	
Clinical skills			

Module 3i: Competencies in the clinical biochemistry of disease: Lipids

Topic	Module 3i Competencies in the clinical biochemistry of disease: Lipids	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of lipids, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the metabolism of apolipoproteins and lipids, including metabolic basis of inherited and acquired hyper- and hypo-lipoproteinaemias • the biochemical basis for atheroma, coronary heart disease and associated risk factors • classification of hyperlipidaemias, including inherited and secondary hyperlipidaemias • primary and secondary cardiovascular disease prevention • laboratory investigation and principles of management of hyperlipidaemia. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the therapeutic and dietary/lifestyle approaches to the management of hyperlipidaemia. 	WPBA	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of lipids, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • to advise clinical teams on the diagnosis, causes, prognosis, and management of dyslipidaemias 	WPBA MSF	2, 3

Module 3j: Competencies in the clinical biochemistry of disease: Cardiovascular system

Topic	Module 3j Competencies in the clinical biochemistry of disease: Cardiovascular system	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the cardiovascular system, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • atheroma, coronary heart disease, stroke and associated risk factors • current methods of calculating risk and their shortcomings, use of biochemical markers for risk stratification in acute coronary syndromes, and biochemical markers of myocardial damage/ventricular function • the biochemical investigation and management of hypertension. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • to estimate cardiovascular risk. 	WPBA MSF	2, 3
Clinical skills			

Module 3k: Competencies in the clinical biochemistry of disease: Diabetes mellitus and glucose

Topic	Module 3k Competencies in the clinical biochemistry of disease: Diabetes mellitus and glucose	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of diabetes mellitus and glucose, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • glucose metabolism • the classification of diabetes, including diagnostic criteria for diabetes, impaired glucose tolerance (IGT) and IFG impaired fasting glucose (IFG) • the pathophysiology of diabetes, including type 1 diabetes, insulin-resistance, type 2 diabetes, and secondary diabetes • the complications of diabetes, such as acute metabolic complications (e.g., diabetic ketoacidosis, hyperosmolar non ketotic hypoglycaemia) and chronic complications such as microvascular (nephropathy, microalbuminuria, neuropathy and retinopathy) and macrovascular (lipid abnormalities, coronary heart disease, peripheral vascular disease) • the principles of treatment of diabetes and monitoring of diabetic control, including use of insulin and other pharmacological agents, dietary modification, home monitoring with meters, continuous glucose monitoring, and laboratory glucose monitoring • the principles of glycosylated haemoglobin, insulin, C-peptide, microalbumin assays • the causes and laboratory investigation of hypoglycaemia in adults and children • metabolic syndrome • inherited forms of diabetes. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the laboratory diagnosis, investigation and management of diabetes mellitus, including methods based upon glucose measurement and glycosylated haemoglobin. • the laboratory's contribution to managing diabetes, including measurement of glucose and glycosylated haemoglobin. • the differences between various causes of diabetes. 	WPBA MSF	2, 3
Clinical skills			

Module 3I: Competencies in the clinical biochemistry of disease: Endocrinology – adult and paediatric

Topic	Module 3I Competencies in the clinical biochemistry of disease: Endocrinology – adult and paediatric	Assessment methods	GSP reference
Learning objective	<p>By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of endocrinology (adult and paediatric), be able to:</p> <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform a range of technical and clinical skills and procedures demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	<p>By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to:</p> <ul style="list-style-type: none"> feedback loops in endocrinology and how they are exploited in diagnostic testing principles of pituitary disease, including acromegaly and dwarfism, prolactinoma/macroprolactin, diabetes insipidus, isolated hormone deficiency and panhypopituitarism dynamic function testing adrenal cortex function and its disorders, including steroid production, Cushing’s syndrome, assessment of reserve, Conn’s syndrome, congenital adrenal hyperplasia pathophysiology of the adrenal medulla, including catecholamine metabolism, phaeochromocytoma, neuroblastoma, and measurement and interpretation of catecholamines and metabolites applied thyroid physiology, including congenital hypothyroidism and screening programmes, hypo- and hyper-thyroidism, autoimmune disease, autoantibodies, tumours including adenoma/carcinoma and medullary thyroid carcinoma the investigation of thyroid disorders, including radioactive iodine <i>in vivo</i> studies, investigation and monitoring therapy and problems of interpretation: binding proteins, drug effects, sick euthyroid syndrome the endocrinology of the gonads, including the pituitary-gonadal axis, sexual differentiation, precocious and delayed puberty, the ovarian cycle, metabolism of testosterone, ovarian failure and menopause, polycystic ovarian syndrome investigation of female; infertility, hirsutism, virilisation hormone-replacement therapy, oral contraceptives – metabolic effects investigation of male infertility, gynaecomastia, feminisation, testicular tumours, testicular failure monitoring of fertility treatment the endocrine effects of cancer, including ectopic hormones, multiple endocrine neoplasia and neuroendocrine tumours. 	FRCPath Part 2 WPBA	2, 3

<p>Technical skills and procedures</p>	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • results of investigations and monitoring therapy • the role of imaging • perform dynamic tests such as insulin stress test and water deprivation tests • assess tests of adrenal function • appropriate monitoring of replacement therapy • appropriate choice of tests to investigate and monitor thyroid disease, according to clinical circumstances • the investigation of female androgenisation. 	<p>WPBA MSF</p>	<p>2, 3</p>
<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of endocrinology (adult and paediatric), be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • liaison with the clinical team on the diagnosis, management and treatment, if appropriate, of the patient. 	<p>WPBA MSF</p>	<p>2, 3</p>

Module 3m: Competencies in the clinical biochemistry of disease: Calcium, magnesium, bone

Topic	Module 3m Competencies in the clinical biochemistry of disease: Calcium, magnesium, bone	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of calcium, magnesium and bone, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the normal physiology and clinical biochemistry of bone metabolism including calcium, magnesium, parathyroid hormone and vitamin D • the causes, investigation, diagnosis, monitoring and management of conditions such as: <ul style="list-style-type: none"> - hyper- and hypo-parathyroidism - hyper and hypocalcaemia: calcium sensor abnormalities - hypo- and hyper-phosphataemia - hypo- and hyper-phosphatasaemia - disorders of magnesium - osteoporosis including steroid therapy and chronic malabsorption - osteomalacia: renal osteodystrophy - Paget's disease - clinical biochemistry of collagen. • the methodologies available for the measurement of: <ul style="list-style-type: none"> - calcium (total, adjusted, ionised) - PTH, vitamin D - biochemical markers of bone disease. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • laboratory investigation of disorders of bone metabolism • laboratory investigations of disorder of bone and mineral metabolism • unsupervised samples for calcium, phosphate, magnesium, parathyroid hormone and vitamin D. 	WPBA MSF	2, 3

<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of calcium, magnesium and bone, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> liaison with the clinical team on the appropriate specimen collection, specimen handling, investigation and monitoring of biochemical tests in disorders of bone and mineral metabolism. 		<p>2, 3</p>
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Module 3n: Competencies in the clinical biochemistry of disease: Nutrition

Topic	Module 3n Competencies in the clinical biochemistry of disease: Nutrition	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of nutrition, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. (N.B. Items in <i>italics</i> would probably not be encountered universally)		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the normal physiology and clinical biochemistry of human nutrition • the causes, investigation, diagnosis, monitoring and management of: <ul style="list-style-type: none"> – protein-energy malnutrition – markers of nutritional status – effects and investigation of vitamin deficiency or excess – trace element deficiency or excess – principles and practical nutritional support – parenteral and enteral – re-feeding syndrome – biochemistry of starvation • obesity: investigation, classification, risk factors, complications • nutritional management of disease • the protein-energy malnutrition found in the following conditions: <ul style="list-style-type: none"> – acute disease: stroke, myocardial infarction, acute renal failure, nephrotic syndrome, acute liver failure – chronic disease: inflammatory bowel disease, coeliac disease, short bowel syndrome, cancer, gall bladder disease, malabsorption – pre- and post-op nutritional assessment, management for oesophagectomy, malignancy, major abdominal surgery • burns, multiple injury, systemic sepsis. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the technical aspects of the biochemical assessment of nutritional deficiencies, treatment, and appropriate clinical and laboratory monitoring of patients receiving nutritional support • the laboratory investigations of disorders of nutrition. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of nutrition, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • liaison with the clinical team on the appropriate specimen collection, specimen handling, investigation, 	WPBA MSF	2, 3

	diagnosis, interpretation and monitoring of biochemical tests in disorders of nutrition.		
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Module 3o: Competencies in the clinical biochemistry of disease: Haemoglobin and porphyrias

Topic	Module 3o Competencies in the clinical biochemistry of disease: Haemoglobin and porphyrias	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of haemoglobin and porphyrias, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. (N.B. Items in <i>italics</i> would probably not be encountered universally)		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the normal physiology and clinical biochemistry of haem biosynthesis and haemoglobin metabolism • the metabolic basis, diagnosis, investigation and monitoring of the following conditions: <ul style="list-style-type: none"> – the acute porphyrias – the cutaneous porphyrias • the causes, investigation, diagnosis, monitoring and management of the following conditions: <ul style="list-style-type: none"> – haemoglobin metabolism – anaemia and its investigation – assessment iron status – detection abnormal haemoglobins: inherited and acquired – metabolic basis of thalassaemia and sickle cell disease, screening – red cell enzyme defects. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the technical aspects of the investigation of disorders of haem biosynthesis (porphyrias) and haemoglobin metabolism • the laboratory investigations of disorders of haem biosynthesis and haemoglobin metabolism. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of haemoglobin and porphyrias, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • liaison with the clinical team on the appropriate specimen collection, specimen handling and monitoring of biochemical tests in disorders of haem biosynthesis (porphyrias), haemoglobin, haem and red cell enzyme metabolism. 	WPBA MSF	2, 3

Module 3p: Competencies in the clinical biochemistry of disease: Enzymology

Topic	Module 3p Competencies in the clinical biochemistry of disease: Enzymology	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of enzymology, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. (N.B. Items in <i>italics</i> would probably not be encountered universally)		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • enzyme stability • the mechanisms for induction of enzymes • the structural basis, separation and quantitation of isoenzymes • the following assays and how they can be used in the investigation, diagnosis, monitoring and management of disease • the limitations of the following tests: <ul style="list-style-type: none"> - amylase and lipase - alkaline phosphatase - aminotransferases - angiotensin converting enzyme - creatine kinase - lactate dehydrogenase - gamma-glutamyl transferase - cholinesterase and variants. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the technical aspects of enzyme analysis • the results of laboratory enzyme analysis • <i>perform unsupervised the analysis of alkaline phosphatase isoenzymes or other isoenzymes.</i> 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of enzymology, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • liaison with the clinical team on the appropriate specimen collection, specimen handling, investigation, diagnosis, interpretation and monitoring conditions involving enzyme analysis. 	WPBA MSF	2, 3

Module 3q: Competencies in the clinical biochemistry of disease: Genetics and molecular biology

Topic	Module 3q Competencies in the clinical biochemistry of disease: Genetics and molecular biology	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of genetics and molecular biology, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. (N.B. Items in <i>italics</i> would probably not be encountered universally)		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the structure of nucleic acids, meiosis and mitosis • the mode of inheritance in the following: <ul style="list-style-type: none"> – simple Mendelian and complex diseases – mitochondrial inheritance • the mode of inheritance for: <ul style="list-style-type: none"> – genetic counselling, antenatal diagnosis and screening • protein synthesis including: <ul style="list-style-type: none"> – transcription and translation – defects in protein synthesis arising from genetic mutations • the molecular pathology of single gene therapy • <i>gene therapy</i>. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the application of Mendelian genetics and Bayes Theorem, and the calculation of pre-and post-test probabilities in genetic counselling. 	WPBA MSF	2, 3

<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of genetics and molecular biology, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> liaison with the clinical team on the appropriate specimen collection, specimen handling, investigation, diagnosis and interpretation of genetic tests within clinical biochemistry. 	<p>WPBA MSF</p>	<p>2, 3</p>
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Module 3r: Competencies in the clinical biochemistry of disease: Pregnancy

Topic	Module 3r Competencies in the clinical biochemistry of disease: Pregnancy	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of pregnancy, be able to: <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform a range of technical and clinical skills and procedures demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> the normal physiology and clinical biochemistry of maternal and fetal development in pregnancy including gestational hormonal changes the causes, investigation, diagnosis, monitoring and management of the complications of pregnancy for example hydatidiform mole and choriocarcinoma the key principles and criteria for the establishing effective pre-natal screening programmes and the current UK provision of pre-natal screening for conditions such as Down's syndrome, fetal malformations, neural tube defects the benefits and risks of screening for gestational diabetes the key principles and criteria for establishing effective neonatal screening programmes and the current UK provision of neonatal screening for inherited metabolic diseases such as phenylketonuria, congenital hypothyroidism, diabetes and congenital liver disease the causes, investigation, diagnosis, monitoring and management of inherited metabolic diseases such as phenylketonuria, congenital hypothyroidism, haemoglobinopathies, and cystic fibrosis. Students' written evaluations of their practice should demonstrate new insights into the application of current theories of clinical biochemistry screening to normal or complex situations in pregnancy.	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> the technical aspects of investigation of maternal and fetal diseases in pregnancy the results of laboratory investigations of routine biochemical tests during normal pregnancy the results of biochemical tests derived from the investigation of diseases of pregnancy, the complications of pregnancy, and fetal diseases in pregnancy the statistical and ethical issues surrounding pre-natal screening the results of laboratory investigations derived from pre-natal screening the statistical and ethical issues surrounding neonatal screening the results of laboratory investigations derived from neonatal screening. Students will be expected to reflect on the challenges of applying research to practice in relation to these	WPBA MSF	2, 3

	procedures and suggest improvements, building on a critique of available evidence.		
Clinical skills	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of pregnancy, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • appropriate specimen collection, specimen handling, investigation, diagnosis, monitoring and management of biochemical tests derived during normal pregnancy, the complications of pregnancy, pre-natal and neonatal screening investigations and programmes • the development of maternal or fetal diseases during pregnancy based on triggers of unusual patterns of results • the principles and outcomes of effective pre-natal and neonatal screening programmes. <p>Students will be required in partnership with the clinical team to identify areas of current practice that could be improved and design and evaluate a suitable intervention based on a critical review of evidence to improve practice.</p>	WPBA MSF	2, 3

Module 3s: Competencies in the clinical biochemistry of disease: Newborn

Topic	Module 3s Competencies in the clinical biochemistry of disease: Newborn	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the newborn, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the normal physiology and biochemistry of neonatal development • the normal fluid balance of the neonate and the biochemical disturbances associated with dehydration and overhydration • the causes, investigation, diagnosis, monitoring and management of conditions such as jaundice, hypoglycaemia, liver disease, hypomagnesaemia, hyperammonaemia, disturbances of calcium and phosphate homeostasis, diseases of prematurity and metabolic bone disease • the principles, practice and rationale for sweat testing in the context of suspected cystic fibrosis • the nutritional requirements of the neonate • the nutritional assessment of the neonate • the causes, investigation, diagnosis, monitoring and management of nutritional disorders of the neonate • the key principles and criteria for establishing effective neonatal screening programmes and the current UK provision of neonatal screening such as phenylketonuria, congenital hypothyroidism, diabetes and congenital liver disease. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the technical aspects of investigation of neonatal diseases • the results of laboratory investigations of biochemical tests in normal neonates • the results of laboratory investigations of biochemical tests in neonatal diseases • the statistical and ethical issues surrounding neonatal screening • the results of laboratory investigations derived from neonatal screening • the technical aspects of the sweat test • the results of the sweat test. 	WPBA MSF	2, 3

<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of the newborn, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • appropriate specimen collection, specimen handling, investigation, diagnosis, interpretation and monitoring of biochemical tests in diseases of neonates such as jaundice, hypoglycaemia, liver disease, hypomagnesaemia, hyperammonaemia, diseases of prematurity, disturbances of calcium and phosphate homeostasis, metabolic bone disease, sweat tests and nutritional disturbances • effective neonatal screening programmes • appropriate application, role and outcome of the sweat test • nutritional assessment and monitoring in neonatal diseases • the potential for the development of neonatal diseases based on triggers of unusual patterns of results • the principles and outcomes of effective neonatal screening programmes. 	<p>WPBA MSF</p>	<p>2, 3</p>
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Module 3t: Competencies in the clinical biochemistry of disease: Childhood

Topic	Module 3t Competencies in the clinical biochemistry of disease: Childhood	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of childhood, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the normal physiology and clinical biochemistry of childhood and understand age-related reference intervals • the causes, investigation, diagnosis, monitoring and management of conditions such as hypoglycaemia, calcium and phosphate disturbances, hyperammonaemia, lactic acidosis, and renal disorders including Fanconi syndrome and tubular defects. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • the technical aspects of investigation of diseases in childhood • laboratory investigations of diseases in childhood. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of childhood, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • specimen collection, specimen handling, investigation, diagnosis, interpretation and monitoring of biochemical tests in diseases in childhood, taking into account age-related reference intervals • the potential for development of childhood disease(s) based on triggers of unusual patterns of results. 	WPBA MSF	2, 3

Module 3u: Competencies in the clinical biochemistry of disease: Inherited metabolic disorders

Topic	Module 3u Competencies in the clinical biochemistry of disease: Inherited metabolic disorders	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of inherited metabolic disorders, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the pathophysiology and biochemical disturbances associated with the common inherited metabolic diseases such as glycogen storage diseases, urea cycle defects • the causes, clinical presentation, investigation, diagnosis, monitoring and management of the common inherited metabolic diseases including glycogen storage diseases, urea cycle defects, amino acid disorders, organic acid disorders • the principles of quantitative and qualitative enzyme abnormalities, the biochemical consequences of primary enzyme blocks in metabolic pathways and the consequential clinical and pathology signs in common inherited metabolic diseases • the principles of detection screening, the methods of investigation and the evaluation of detection programmes in common inherited metabolic diseases • the key principles and criteria for establishing effective screening programmes for inherited metabolic diseases • the methods for the investigation, diagnosis and monitoring of disorders of amino acid metabolism, carbohydrate metabolism, cerebral lipidoses, fatty acid oxidation defects, disorders of metal metabolism, mitochondrial disorders, mucopolysaccharidoses, organic acid disorders, peroxisomal disorders, primary and secondary purine and pyrimidine disorders, transport defects and urea cycle disorders • the pre-natal investigation of inherited metabolic diseases of the fetus • the causes, investigation, diagnosis, monitoring and management of encephalopathy and hyperammonaemia • the analysis of amino acids, organic acids, carnitine, acyl carnitines, enzyme assays, mucopolysaccharidoses, tissue culture and DNA in the investigation, diagnosis, monitoring and management of inherited metabolic diseases • the presentation, investigation and mechanism of inheritance of the common inherited metabolic diseases like urea cycle defects, glycogen storage diseases, fatty acid oxidation defects, and phenylketonuria • the principles of treatment of inherited metabolic diseases such as co-enzyme supplementation, enzyme inhibition and dietary manipulation 	FRCPATH Part 2 WPBA	2, 3

	<ul style="list-style-type: none"> the effects of inborn errors of metabolism/inherited metabolic diseases on routine biochemical tests the effects of metabolic stress on patients with in born errors of metabolism/inherited metabolic diseases such as phenylketonuria, fatty acid oxidation defects, glycogen storage disease and urea cycle defects. 		
Technical skills and procedures	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> the technical aspects of investigation of inherited metabolic diseases the technical aspects of the investigations of pre- and neonatal screening for inherited metabolic diseases the appropriate specimens for the effective investigation of suspected inherited metabolic diseases like glycogen storage diseases, urea cycle defects, fatty acid oxidation defects, hyperammonaemia, hypoglycaemia the statistical and ethical issues surrounding pre- and neonatal screening the results of laboratory investigations derived from pre- and neonatal screening programmes. <p>Trainees are not expected to have an in-depth knowledge of all inherited metabolic diseases but should be aware of the major categories, common presentations, investigation, mechanism of inheritance, scope of pre and neonatal diagnosis and the principles of treatment for example via co-enzyme supplementation, enzyme inhibition and dietary manipulation.</p>	WPBA MSF	2, 3
Clinical skills	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of inherited metabolic disorders, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> appropriate specimen collection, specimen handling, investigation, diagnosis and monitoring of biochemical tests in inherited metabolic diseases the potential for the development of inherited metabolic diseases based on triggers of unusual patterns of results the principles and outcomes of effective pre- and neonatal screening programmes. 	WPBA MSF	2, 3

Module 3v: Competencies in the clinical biochemistry of disease: Neuromuscular system

Topic	Module 3v Competencies in the clinical biochemistry of disease: Neuromuscular system	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the neuromuscular system, be able to: <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform a range of technical and clinical skills and procedures demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> the normal physiology, biochemistry, formation and composition of cerebrospinal fluid the pathophysiology and biochemical disturbances associated with neuromuscular disorders like multiple sclerosis, muscular dystrophy, Parkinson's disease, psychiatric disorders and muscle disease the causes, investigation, diagnosis, monitoring and management of neuromuscular disorders like multiple sclerosis, muscular dystrophy, Parkinson's diseases and muscle disease the biochemistry of psychiatric disease the role of biochemistry in the investigation, monitoring and management of psychiatric disease the normal physiology and biochemistry of muscle the role of biochemistry in the investigation, diagnosis, monitoring and management of muscle disease the role of muscle biopsy in the investigation and diagnosis of muscle disease the role of cerebrospinal fluid in the investigation and diagnosis of neurological disorders such as meningitis and suspected sub-arachnoid haemorrhage (SAH). 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> the technical aspects of the investigation of neuromuscular disorders, psychiatric diseases and muscle disease the results of laboratory investigations of biochemical tests in neuromuscular, psychiatric and muscle diseases spectroscopy of cerebrospinal fluid in the investigation of suspected sub-arachnoid haemorrhage the results of spectroscopy derived from the analysis of cerebrospinal fluid in the investigation of suspected sub-arachnoid haemorrhage the results of cerebrospinal fluid electrophoresis and immunofixation electrophoresis in the investigation, diagnosis and monitoring of suspected multiple sclerosis. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of the neuromuscular system, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> the appropriate specimen collection, specimen handling, investigation, diagnosis and monitoring of biochemical tests in neuromuscular diseases, muscle diseases and psychiatric diseases 	WPBA MSF	2, 3

	<ul style="list-style-type: none">the potential for the development of neuromuscular, muscle or psychiatric diseases based on triggers of unusual patterns of results.		
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Module 3w: Competencies in the clinical biochemistry of disease: Cancer

Topic	Module 3w Competencies in the clinical biochemistry of disease: Cancer	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of cancer, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the range of tumour markers undertaken in clinical biochemistry laboratories and their relationship to specific types of cancer including prostate, lung, breast ovarian, thyroid, pituitary, adrenal, liver, testicular cancers and those of the gastro-intestinal tract • methods of measurement and the clinical significance of tumour markers undertaken within clinical biochemistry • pathological processes that lead to the production of tumour markers • the criteria for an ideal tumour marker • how tumour markers may be utilised in screening, diagnosis, monitoring and prognosis • the uses and limitations of serum, urine and other fluid tumour markers in terms of diagnostic specificity, sensitivity, reference ranges and serial measurements • the techniques used for the analysis of tumour markers and their relative merits • the principles and limitation of immunoassays in tumour marker analysis. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • specialist tumour marker analysis and explain the results obtained • tumour marker results • the appropriateness of use of biochemical tumour markers for different types of cancer in the context of screening, diagnosis and monitoring • the interpretation of tumour marker results in the context of the limitations of the analytical techniques used. 	WPBA MSF	2, 3

<p>Clinical skills</p>	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of cancer, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • liaison with both general physicians and oncologists on the interpretation of tumour marker results. 	<p>WPBA MSF</p>	<p>2, 3</p>
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Module 3x: Competencies in the clinical biochemistry of disease: Metabolic response

Topic	Module 3x Competencies in the clinical biochemistry of disease: Metabolic response	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of the metabolic response, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the changes to biochemical markers as part of acute and chronic responses to disease processes • the tests undertaken in intensive care to support patient recovery including those used as POCT investigations • the temporal changes of markers utilised to monitor patient status including the main organ profiles of significance. 	FRCPath Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • biochemical investigations, monitoring and management, especially patients in ITU/HDU • different analytical techniques for the measurement of biochemical parameters particularly where more than one measurement method may be available to clinicians. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of the metabolic response, be able to perform the clinical skills necessary to manage under supervision: <ul style="list-style-type: none"> • critically ill patients in intensive care locations with respect to biochemical results and metabolic observations • the potential for development of childhood disease(s) based on triggers of unusual patterns of results. 	WPBA MSF	2, 3

Module 3y: Competencies in the clinical biochemistry of disease: Therapeutic drug monitoring and toxicology

Topic	Module 3y Competencies in the clinical biochemistry of disease: Therapeutic drug monitoring and toxicology	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the clinical biochemistry of therapeutic drug monitoring and toxicology, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. (N.B. Items in <i>italics</i> would probably not be encountered universally)		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • the basic principles of pharmacokinetics including absorption, distribution, metabolism and excretion. Explain in the context of TDM the impact that diseases of the GI tract, liver and kidneys may have on drug metabolism • the toxic effects of drugs and how they arise, including drugs commonly used for control of blood pressure, such as diuretics, ACE inhibitors and angiotensin receptor blockers • the general principles of pharmacogenomics in the context of TDM and toxicology and how the clinical biochemistry laboratory can support more effective treatment. • the clinical benefits of therapeutically monitored drugs, their potential side effects and the rationale for concentration monitoring of commonly requested drugs and their metabolites including digoxin, lithium, anti-epileptics, theophylline, caffeine, methotrexate, immunosuppressives and antibiotics • the metabolic effects of ethanol • the laboratory investigation of a patient who has taken an overdose and in particular the laboratory analysis of salicylate, paracetamol, and other drugs • the support that clinical biochemistry may offer to drug addiction services including compliance testing for methadone treatment and the testing of commonly abused drugs such as opiates, amphetamine, methylenedioxy-methamphetamine (MDMA), benzodiazepines, cocaine • the principles of laboratory testing related to the poisoned patient such as assessment of carbon monoxide exposure and analysis of paraquat, iron, ethylene glycol, methanol, organophosphate compounds, lead, mercury, aluminium • the laboratory investigation of the unconscious patient • the principles of analytical techniques used for TDM and toxicology, including spectrophotometry, immunoassay, GC, HPLC and mass spectrometry • the advantages and disadvantages of different analytical techniques for the analysis of both therapeutic and abused drugs • the legal framework for screening for drugs, including pre-employment screening, industrial health screening and drugs of abuse screening • the principles and legal implications of specimen collection, chain of custody, release of results and 	FRCPATH Part 2 WPBA	2, 3

	<p>employer responsibilities related to drugs of abuse screening and forensic science</p> <ul style="list-style-type: none"> • the requirements associated with storage and security of drugs • the requirements to confirm drug screening results with techniques with superior methods that are based on different analytical principles • the relative benefits of different sample materials including blood, urine, saliva and hair in toxicological investigations • how to investigate post-mortem toxicology cases. 		
Technical skills and procedures	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • the sample types and sampling requirements for TDM including factors that may lead to variation in circulating concentrations relative to half-life, dosage, the effect of changing dose, and the use of peak/trough levels • the biochemical assessment of a patient who has taken an overdose or who has been exposed to a poison • factors that affect drug action or metabolism • appropriate investigations to ascertain the cause of death in post-mortem analysis • interactions with the police and the coroner with respect to due process in the investigation of death. 	WPBA MSF	2, 3
Clinical skills	<p>By the end of the training period trainees will, in respect of the competencies in the clinical biochemistry of therapeutic drug monitoring and toxicology, be able to perform the clinical skills necessary to manage under supervision:</p> <ul style="list-style-type: none"> • liaison with clinical teams on strategies for therapeutic drug monitoring • liaison with clinical teams on the laboratory support and advice offered to support the management of the patients who may have overdosed or who may be unconscious due to an unknown cause. • liaison with drug rehabilitation teams, the forensic service and the police in the context of drug abuse to manage both the clinical and legal aspects • to advise and support coroner work in the investigations of suspicious deaths. 	WPBA MSF	2, 3

Module of curriculum: Module 4

(This module to be examined in FRCPATH Part 2 examination)

Module 4a: Competencies in clinical care

Topic	Module 4a Competencies in clinical care	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in clinical care, be able to: <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform, adapt and master a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • how the clinical history contributes to the assessment of a patient • how a clinical condition might present. 	FRCPATH Part 2 WPBA	1, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • how a clinician might educate a patient concerning a particular disease, including prevention, therapy and outcomes. 	WPBA MSF	1, 3
Clinical skills	By the end of the training period the trainee will be able to apply knowledge of competencies in clinical care to perform, adapt and master the clinical skills necessary to manage: <ul style="list-style-type: none"> • to give an example of a clinical history that led to a diagnosis • to write a clinical report concerning the results of an investigation • to write a short article describing the role of a patient support group. 	WPBA MSF	1, 3

Module 4b: Laboratory management competencies

Topic	Module 4b Laboratory management competencies	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in laboratory management, be able to <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform, adapt and master a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <p>General</p> <ul style="list-style-type: none"> • request initiation, specimen transport and what contributes to error • the analytical and reporting process • principles of successful management • the structure and organisation of the NHS, where decision making occurs, process of change and ways of influencing decisions • practical experience of business planning, finance, financial control, costing, pricing, contracting, purchasing, resource management • practical aspects of personnel management, industrial relations, team building, staff training, motivation, continuing education, appraisal, dealing with problems, colleagues • the concepts of accreditation, e.g. CPA, good laboratory practice, MHRA, HTA, etc. • legal requirements and Department of Health guidance for laboratories • multidisciplinary working. <p>Quality assurance</p> <ul style="list-style-type: none"> • quality control and quality assurance are used in the laboratory including interpretation of results of quality assurance • how laboratory accreditation is obtained. <p>Health and safety</p> <ul style="list-style-type: none"> • the principles of Health and safety and COSHH • differences between individual and collective responsibility • how to handle potentially infectious samples and noxious chemicals • radiation protection measures • the principles of mechanical, fire and electrical safety • how to deal with an accident. <p>Selection of analytical equipment</p>	FRCPATH Part 2 WPBA	1, 2, 5

	<ul style="list-style-type: none"> the process of specification and evaluation of an analytical system financial issues relating to analyser installation (capital purchase, reagent rental, competitive tendering). <p>IT</p> <ul style="list-style-type: none"> the role of IT in delivery and management of service stages in producing results and problems with turnaround time instrument interfaces and links to other computers reporting/authorisation procedures patient identification and methods of ensuring accuracy management statistics the Data Protection Act and the Freedom of Information Act retention of records how to undertake a review of pathology services. <p>Communication skills</p> <ul style="list-style-type: none"> how to communicate with organisations, scientific and medical communities and the public principles of effective negotiation, influencing colleagues. 		
<p>Technical skills and procedures</p>	<p>By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> the processes in reception the place of laboratory automation and IT personnel management including industrial relations the processes of business planning, writing business case, contracting, finance, and resource management the process of appointing staff appraisal of a member of staff and the skills required a departmental management meeting mentoring and supervision how compliance with CPA standards affects training an accreditation review of a section of the laboratory how to interpret quality control/quality assurance data and advise on subsequent course of action act as a laboratory quality control officer laboratory quality control meetings, safety committee meetings the role of IT in clinical biochemistry how to resolve technical, scientific, clinical and management problems through leadership skills and promoting morale laboratory procedures to patients, their relatives and visitors 	<p>WPBA MSF</p>	<p>1, 2, 5</p>

	<ul style="list-style-type: none"> • how to work within a team, communicating with clinical, managerial and other healthcare staff • how to prepare and present a summary of a scientific study. 		
Clinical skills		WPBA MSF	

Module 4c: Competencies in the interpretation of laboratory data

Topic	Module 4c Competencies in the interpretation of laboratory data	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of competencies in the interpretation of laboratory data, be able to <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform, adapt and master a range of technical and clinical skills and procedures • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. In addition, he/she will be confident in his/her contribution to the construction, organisation and interpretation of clinical research projects		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • biochemistry and physiology of a broad range of disease processes associated with the investigations undertaken in the clinical biochemistry laboratory under investigation in the laboratory • scope of biochemical investigations undertaken and provided by clinical biochemistry to other specialties. 	FRCPATH Part 2 WPBA	2, 3
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • biochemical investigations undertaken in clinical biochemistry laboratory • clinical biochemistry aspects of patient care at ward rounds and case presentations • biochemical results and data, advising clinicians whilst undertaking the role of duty biochemist and reporting rota, taking into consideration results from all laboratory disciplines • how to apply appropriate comments when reporting laboratory results. 	WPBA MSF	2, 3
Clinical skills	By the end of the training period the trainee will be able to apply knowledge of competencies in the interpretation of laboratory data to perform, adapt and master the clinical skills necessary to manage the: <ul style="list-style-type: none"> • liaison with clinical colleagues who require advice on appropriate diagnostic tests • liaison with and advise clinical teams on the results of biochemical tests in an appropriate timescale relative to the severity of condition under investigation • follow up of abnormal investigations. 	WPBA MSF	2, 3

Module 4d: Leadership and management

Topic	Module 4d Leadership and management	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of leadership and management, be able to <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform, adapt and master a range of skills and • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • good laboratory management: <ul style="list-style-type: none"> - explain the concepts of good laboratory practice - summarise the process of management and being managed • describing the criteria and process for laboratory accreditation <ul style="list-style-type: none"> - describe and explain quality system management and accreditation (UKAS, ISO) - describe and explain test validation and verification and related quality assurance processes • how the appraisal process works • the process of clinical audit • the importance of clinical governance and delivery of high-quality standards in clinical biochemistry: <ul style="list-style-type: none"> - describe the concept of clinical risk management and procedures designed to minimise risks - outline the importance of patient consent to use data or specimens for ethically approved research or teaching • the current organisation of NHS and allied organisations <ul style="list-style-type: none"> - outline the healthcare structures • the role of the Care Quality Commission (CQC) <ul style="list-style-type: none"> - understand the roles of 'arm's length bodies' involved in health protection including the Public Health England (PHE) Food Standards Agency (FSA), MHRA and NICE • demonstrate: <ul style="list-style-type: none"> - a working knowledge of laboratory data entry and retrieval and surveillance systems - an understanding of the Data Protection Act - justify the requirements for patient confidentiality and the Caldicott principles • an understanding of: <ul style="list-style-type: none"> - employment law - staff appointment procedures - related issues including equality and diversity legislation - European working time directive requirements - career progression - remuneration scales and banding of laboratory scientific staff. 	FRCPath Part 2 WPBA	1, 2, 3, 5
Technical skills and	By the end of the training period the trainee will be able to demonstrate a critical understanding of current	WPBA	1, 2, 3, 5

<p>procedures</p>	<p>relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills:</p> <ul style="list-style-type: none"> • awareness of organisation and structure of a clinical biochemistry laboratory including: <ul style="list-style-type: none"> - staffing and financial issues - planning - implementation of policies and rotas. • implement these criteria • use constructive listening, mentoring, and appraisal skills • use personal appraisal constructively • audit and evaluate: <ul style="list-style-type: none"> - personal and departmental activities - existing and new tests, techniques or clinical services • present information utilising presentation and public speaking skills • organise teaching • search electronic databases and use the Internet as a learning and communication resource: <ul style="list-style-type: none"> - perform, adapt and master the use of database, word processing and statistics programmes - define how to undertake searches - apply the principles of confidentiality and their implementation in terms of clinical practice. 	<p>MSF</p>	
<p>Clinical skills</p>	<p>By the end of the training period the trainee will be able to apply knowledge of leadership and management to perform, adapt and master the clinical skills necessary to manage the</p> <ul style="list-style-type: none"> • appropriate laboratory diagnostic repertoire and research and innovation programmes to maintain a cutting edge diagnostic service 	<p>WPBA MSF</p>	<p>3, 5</p>

Module 4e: Training and education

Topic	Module 4e Training and education	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of training and education, be able to <ul style="list-style-type: none"> • analyse, synthesise, evaluate and apply knowledge • perform, adapt and master a range of skills and • demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> • a range of teaching and assessment methods including the underpinning evidence base • a range of different mentoring styles from the perspective of the learner and the teacher • the background knowledge of different healthcare groups at different stages of their career development and the need to establish what the learner already knows • the curricula and training and assessment guidelines relating to colleagues being closely supervised • good knowledge of the clinical context before teaching or training others. 	FRCPATH Part 2 WPBA	1
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> • plan, prepare and evaluate a PowerPoint presentation • perform literature searches to prepare teaching material • plan, prepare and evaluate clinical and technical skills teaching sessions • have empathy with other trainees and be able to deal effectively with those who need additional support. 	WPBA MSF	1
Clinical skills	By the end of the training period the trainee will be able to apply knowledge of training and education to perform, adapt and master the clinical skills necessary to manage <ul style="list-style-type: none"> • good interpersonal and communication skills • skills in supervising, mentoring and assessing. 	WPBA MSF	1, 3

Module 4f: Research, development and innovation

All HSS Trainees to undertake doctoral level research that either (i) meets the research requirements of the doctoral level training programme or (ii) results in a coherent body of papers that reaches the standard suitable for publication in peer reviewed journals, undertaken during the HSST programme *or in the immediate 3 years prior to HSST*. They will also be expected to present and defend their research at national /international scientific conferences.

Topic	Module 4f Research, development and innovation	Assessment methods	GSP reference
Learning objective	By the end of the training period trainees will, in respect of research, development and innovation, be able to <ul style="list-style-type: none"> analyse, synthesise, evaluate and apply knowledge perform, adapt and master a range of technical and clinical skills and procedures demonstrate the attitudes and behaviours necessary for professional practice as a consultant clinical scientist dealing with the complexities, uncertainties and tensions of professional practice at this level. 		
Knowledge	By the end of the training period the trainee will be able to demonstrate the ability to analyse, evaluate and synthesise relevant knowledge and its application to their professional practice in relation to: <ul style="list-style-type: none"> the principles of critical review. how statistical methods are used to describe datasets, how agreement can be assessed, how confidence intervals are constructed. methods for assessing the utility of tests the steps to be taken in planning a research and development project research governance and the steps to be taken to conduct and supervise a valid research and development project the regulatory requirements including the research governance framework, ethical framework and intellectual property that must be considered in the area of study how to critically appraise the results of a research and development project, draw conclusions in the correct clinical context, where appropriate, use them to plan follow up research and development the variety of ways in which research and development findings can be reported and communicated to peers and other interested parties the steps required to translate successful research findings into service in the interests of patient care. 	FRCPATH Part 2 WPBA	1, 2, 3, 4
Technical skills and procedures	By the end of the training period the trainee will be able to demonstrate a critical understanding of current relevant research, theory and knowledge and its application to the performance, adaptation and mastery of the following technical procedures and laboratory skills: <ul style="list-style-type: none"> how to undertake a critical appraisal of literature. how to critique a published research paper plan a research and development project conduct and/or supervise a valid research and development project critically appraise the results of a research and development project, draw conclusions in the correct clinical context, and, where appropriate, use them to plan follow up research and development use of a variety of ways in which research and development findings has been reported and communicated to peers and other interested parties 	WPBA MSF	1, 3, 4

	<ul style="list-style-type: none"> translate successful research findings into service and provide examples of where this has been achieved. 		
Clinical skills			

Appendix 1 Acronyms and abbreviations

ACE	Angiotensin converting enzyme
AHCS	Academy for Healthcare Science
AHSN	Academic Health Science Network
AoMRC	Academy of Medical Royal Colleges
AUC-ROC	Area under the curve
BMS	Biomedical scientist
CbD	Case-based discussion
CCHST	Certificate of Completion of Higher Scientific Training
COSHH	Control of Substances Hazardous to Health
CPA	Clinical Pathology Accreditation
CPPD	Continuing Personal and Professional Development
CQC	Care Quality Commission
CSO	Chief Scientific Officer
DH	Department of Health
DNA	Deoxyribonucleic acid
DOPS	Directly observed practical skills
FRB	Final Review Board
FRCPATH	Fellowship of the Royal College of Pathologists
FSA	Food Standards Agency
GC	Gas chromatography
GCP	Good Clinical Practice
GMC	General Medical Council
GSP	Good Scientific Practice
HCPC	Health Care Professions Council
HCS	Healthcare science
HDU	High dependency unit
HEE	Health Education England
HEI	Higher Education institution
HPLC	High performance liquid chromatography
HSS	Higher Specialist Scientist
HSST	Higher Specialist Scientific Training
ICS	Innovation in Clinical Sciences
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IT	Information technology
ITU	Intensive Therapy Unit
LETBs	Local Education and Training Boards
MAHSE	Manchester Academy for Healthcare Science Education

MDMA	Methylenedioxy-methamphetamine
MDT	Multi-Disciplinary Team
MHRA	Medicines and Healthcare products Regulatory Agency
MSC	Modernising Scientific Careers
MSF	Multisource feedback
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
NSHCS	National School of Healthcare Science
OCE	Observed Clinical Event
OLAT	Online Learning and Assessment Tool
OSCSA	Objective Structured Clinical Skills Assessment
OSFA	Objective Structured Final Assessment
PCR	Polymerase chain reaction
PD	Professional Doctorate
PHE	Public Health England
POCT	Point of care testing
PSA	Professional Standards Authority
PTH	Parathyroid hormone
QA	Quality assurance
RCPATH	The Royal College of Pathologists
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RNA	Ribonucleic acid
SAH	Sub-arachnoid haemorrhage
STARD	Standards for Reporting of Diagnostic Accuracy
STP	Scientist Training Programme
TDM	Therapeutic drug monitoring
UV	Ultra violet
WPBA	Work-place based assessment