



المجلس العماني للإختصاصات الطبية
OMAN MEDICAL SPECIALTY BOARD

CURRICULUM FOR TRAINING

IN

CLINICAL BIOCHEMISTRY

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INTRODUCTION

Clinical biochemistry encompasses both practical laboratory and clinical skills. The award of the Certificate of Completion of Training (CCT) will require evidence of satisfactory completion of training in both the Good Medical Practice and core aspects of Clinical Biochemistry, which are outlined in this curriculum. The curriculum complies with the Postgraduate Medical Education and Training Board Recommendation of the Oman Medical Specialization Board (OMSB) that will be integrated to produce a coordinated training package. The relevant documentation of the curriculum has been developed with reference to the curriculum recommended by the Royal College of Pathologists.

ENTRY REQUIREMENT

Trainees are eligible for entry to a clinical biochemistry training programme following satisfactory completion of a foundation training programme or equivalent. This is usually achieved by a minimum of 2 year post-graduation clinical training. Selection of the trainees will be achieved following an interview, prior to entry to the programme, by the OMSB Clinical Biochemistry Committee. .

DURATION OF TRAINING

The OMSB anticipates that training of five and half years duration would normally be required to satisfactorily complete the clinical biochemistry curriculum to the required depth and breadth. The CCT in clinical biochemistry will be awarded on the recommendation of the OMSB following evidence of:

- satisfactory completion of the clinical biochemistry curriculum (including workplace based assessments) and the minimum training period
- attainment of the OMSB's Clinical Biochemistry Year 1 Assessment
- OMSB membership examination or MRCPPath examination

RATIONALE

Purpose of the curriculum

The purpose of the curriculum for higher specialist training in clinical biochemistry (clinical chemistry or chemical pathology) is to set the standards required by the OMSB and recognized by other international bodies, the Royal College of Pathologists in UK, Australia and Canada. This will ensure that trainees are fully prepared to lead a full clinical and clinical biochemistry laboratory service at consultant level. The educational programme provides:

- ✚ experience of laboratory practice to enable the trainee to attain an understanding of biochemical process associated with pathological change, the rationale for investigation and treatment of disease and the interpretation of test results and to provide a basis for research activity
- ✚ experience of the diagnostic techniques required to become technically competent in practical work, and to master the underlying analytical and clinical principles
- ✚ the opportunity to gain knowledge of the metabolic changes that occur in disease
- ✚ the opportunity to gain knowledge of specialist areas such as paediatric clinical biochemistry and toxicology, in order to be able to provide specialist advice
- ✚ training in the communication and teaching skills necessary for effective practice
- ✚ the acquisition of the ability to provide specialist opinion in clinical biochemistry
- ✚ the acquisition of management skills to lead a department providing an effective service
- ✚ experience of research and development projects and critical assessment of published work so as to contribute in a team and individually to the development of the service .
- ✚ the acquisition of life-long habits of reading, literature searches, consultation with colleagues, attendance at scientific meetings, and the presentation of scientific work that are essential for Continuing Professional Development (CPD).
- ✚ Experience of the practice of clinical governance and audit (specialist and multidisciplinary) through evaluation of practice against the standards of evidence-based medicine, which underpin biochemistry practice.

The balance between practical laboratory and clinical training will be influenced by educational background, personal interests and guidance from supervisors. The acquisition of clinical competence is required particularly in endocrinology, metabolic medicine, nutrition, inborn errors of metabolism, disorders of lipid metabolism and cardiovascular risk assessment, disorders of calcium metabolism and bone and diabetes mellitus. The curriculum will facilitate regular assessment of trainees' progress by trainees and their trainers.

CURRICULUM DEVELOPMENT

The curriculum was developed by the OMSB Clinical Biochemistry Committee with input from the curriculum of The Royal College of Pathologist, UK. It will allow trainees to take control of their own learning and to measure achievement against objectives. It will also help in formulation of a regularly updated education plan in conjunction with an educational supervisor and the local specialty training committee.

STAGES OF TRAINING

There are two stages in the clinical biochemistry curriculum. Trainees may not progress to the next stage of training until they have satisfactorily completed the preceding stage.

Stage A (R1, R2 R3)

This stage consists of 3 years of full-time training. The first year of the training period (R1) will begin with a formal induction to the different aspects of laboratory medicine including clinical biochemistry. The trainee will undergo rotation in the different branches of the laboratory (haematology, microbiology, histopathology, cytogenetics as well as clinical biochemistry). In addition, clinical rotation in the relevant fields (endocrinology, nephrology, lipidology, paediatric/ metabolic medicine) should be achieved. The trainee should focus on his/her laboratory/clinical rotation on the relationship of such field on the profession of clinical biochemistry. The trainee should also receive instruction and practical experience in general aspects of clinical biochemistry, both laboratory and clinical. This will take 12 month training (R1) at the end of which the residents will sit for OMSB Clinical Biochemistry Year 1 Assessment (Core Examination), when they pass they move to (R2). During the second year (R2) and third year (R3), the trainees will broaden their experience and understanding of clinical biochemistry. The trainee should has a good general knowledge and understanding of most principles and practices under indirect supervision. He/she should be able to deal with most of the day-to-day issues in a hospital clinical biochemistry laboratory to an adequate level but will still require consultant input with regard to complex management and clinical issues. The trainee should complete the required training in the related clinical fields, if this has not been achieved during R1. Stage A training will be assessed by the OMSB Part 1 examination or MRCPPath Part 1 examination. During this period, enrolling in a course leading to an MSc (Clinical Biochemistry), would be very beneficial and highly recommended, because not all theoretical aspects of training can be covered in the workplace. The availability of such MSc program at Sultan Qaboos University (SQU) should encourage trainees to get benefit of it (full-time or part-time) as the core training program before Part 1 examination. Candidates who pass the MRCPPath Part 1 examination (which is available bi-annually in Muscat centre) may be given exemption from OMSB Part 1 examination. Acquisition of professional qualification in medicine (eg: MRCP) will be highly recommended, if the trainees possess during their study.

Stage B (R4 and R5)

Stage B of training consists of two and half year of training (R4 and R5). This stage of the curriculum enables the trainee to undertake further specialized general clinical biochemistry training and related metabolic medicine. Up to 12 months of this time may be used for an approved research project subject to prospective approval by the OMSB. If residents complete their fourth year of training (R4) in Oman satisfactory, they will move to (R5) and will be recommended to spend a minimum of 1 year advanced training in the UK, Australia or Canada. At the end of this training abroad, the resident is expected to pass the Part 2 OMSB examination or/ and MRCPPath examination or/and equivalent examination. The trainee should have an in-depth knowledge and understanding of the principles of clinical biochemistry satisfactorily and has completed all core and generic areas of the clinical biochemistry curriculum. He/she should be competent to discuss and deal with the subject (or, where appropriate, perform the task/procedure), demonstrating a level of clinical or professional judgment commensurate with independent professional practice at consultant level. It is anticipated that a trainee at this level should have consultant input readily available at all times where required. By the end of Stage B, the trainee should be able to demonstrate a level of knowledge and skill indicating suitability for independent professional practice in clinical biochemistry. Throughout all the stages, the trainees should be encouraged to attend relevant high specialist training courses, symposia and conferences, particularly those which are organized by academic/professional associations such as the Association for Clinical Biochemistry (ACB), UK, American Association of Clinical Chemistry (AACC) and others.

Training Programmes

Training programmes should be recognised by other international colleges of interest. It should include suitable rotational arrangements to cover all the necessary areas of the curriculum and should include an appropriate balance between all the teaching hospitals. The exact rotational arrangements will vary according to the size of the departments in the various training hospitals, the number of placements on the training scheme and the number of placements on the training scheme and the number of other trainees on the training programme. The structure and operation of the training programme will ensure that every trainee is provided with an appropriate range of educational experience to complete his/ her training. At present the recommended centers for training are: Sultan Qaboos University Hospital, Royal Hospital and Khoula Hospital.

CONTENT OF LEARNING

The curriculum details the level of knowledge and skill that a trainee should acquire to provide a high quality service at consultant level. The general professional and specialty-specific content of the curriculum is outlined below:

Generic skills required for Clinical Biochemistry, in accordance with Good Medical Basic knowledge and skills

1. Laboratory aspects of Clinical Biochemistry:

The trainee should aim to become a competent analyst with a thorough understanding of method development, performance and application. Extensive experience of all laboratory techniques is not expected but trainees should gain in-depth practical experience of techniques used for the commonly measured analytes, and of other more specialized techniques available as required to provide a critical insight into laboratory methodology. They should at least observed all other techniques listed in the curriculum. Theoretical knowledge of the analytical techniques is essential in order to develop a critical attitude to the principles underlying methods and instrumentation, their performance and usefulness in the clinical setting. Laboratory problems and calculations should be used to create learning opportunities. Trainees must become proficient in the theory and application of data handling and statistical methods.

2. Management and communication:

Trainees must gain experience under supervision in formulating departmental policies and clinical guidelines and in applying the leadership and teamwork skills that are necessary to implement them. Communication skills should be developed by report writing, presentation of data at group discussion and meetings including departmental meetings. Trainees should experience strategic planning, preparation of a business plan, contracting process, service level agreements and departmental and directorate budgeting. Formal training should be gained by attending suitable management courses. Trainees, as colleagues, should sit on departmental directorate and committee meetings as observers in order to gain experience of committee procedures, aspects of confidentiality, decision-making and the importance of maintaining good interpersonal relationships.

3. Clinical governance, clinical audit and evidence-based medicine:

Clinical governance is defined by the Department of Health as ‘a framework through which NHS organizations 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. In clinical biochemistry, trainees must acquire knowledge of the lines of accountability, quality improvement programmes, clinical audit, evidence-based practice, clinical standards and guidelines, managing risk and quality assurance programmes. Training in these areas must continue throughout all stages of the curriculum.

4. Clinical training:

Trainees must acquire a detailed understanding of biochemical process and the changes that occur in disease. They must then develop the skills to use this knowledge in the diagnosis and management of disease. They must also develop an understanding of the rationale for investigation and treatment of disease and the usefulness and limitations of laboratory tests in these settings. Trainees are not required to know every aspect, as certain conditions is rare. Knowledge of where to obtain relevant information is required.

5. Direct patient care in the outpatient setting:

This forms an important part of training. The specialty experience gained will vary but the majority of trainees will gain expertise in at least two areas, e.g. disorders of lipids, diabetes and nutrition.

6. Recent advances in the clinical and laboratory aspects of the subject as published in scientific literature:

The curriculum outlines the knowledge, skills, attitudes and expertise that a trainee is expected to obtain. It is expected that every trainee should undertake the core training but it is recognized that the sequencing of learning and experience will differ according to the programme. The curriculum maps components of *Good Medical Practice* against the clinical components of chemical biochemistry.

On completion of the clinical biochemistry training programme, the trainee must have acquired and be able to demonstrate:

- appropriate attitudes in order to be able to work as a consultant
- good working relationships with colleagues and the appropriate communication skills required for the practice of clinical biochemistry
- the knowledge, skills and attitudes to act in a professional manner at all times
- the knowledge, skills and attitudes to provide appropriate teaching and to participate in effective research to underpin clinical biochemistry practice
- an understanding of the context, meaning and implementation of clinical governance
- a knowledge of the structure and organization of the Health Service
- the acquisition of management skills required for the running of a clinical biochemistry laboratory
- familiarity with health and safety regulations, as applied to the work of a clinical biochemistry department.

METHODS OF ASSESSMENT

The major summative assessment will occur towards the end of the third year of training in the shape of the OMSB Part 1 or MRCPPath Part 1 examination, and towards the end of the fifth and half year of training in the shape of the OMSB Part 2 or MRCPPath Part 2 examination. Continuous appraisal through training will be undertaken by the educational supervisor and other senior members of staff, including competency based assessments. The detailed procedures observed by the educational supervisor and judge to be satisfactory will be recorded in the trainee's logbook. A correctly maintained/up-to-date logbook and portfolio will be used as evidence for satisfactory progress.

MODEL OF LEARNING

The models of learning can be applied to any stage of training in varying degrees. The majority of the curriculum will be delivered through work-based experimental learning, but the environment within the department should 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 as those organized biannually by the Association for the Clinical Biochemistry, UK. Independent self-directed learning should be encouraged by providing reference text books and journals. The rotation should also be arranged in such a way that trainees have time available for participation in research projects as part of their training or a more sustained period of working towards an MSc.

LEARNING EXPERIENCES

The following teaching/learning methods will be used to identify how individual objectives will be achieved:

- a. observation of, assisting and discussion with senior staff
- b. task specific on the job training
- c. observation of laboratory methods
- d. personal study
- e. appropriate postgraduate education courses
- f. tailored clinical experience
- g. laboratory and clinical team meetings
- h. undertaking a laboratory - based project
- i. practical bench work

SUPERVISION AND FEEDBACK

During the five and half year of specialist training, the training will be supervised by the senior medical and scientific staff on a day-to-day basis under the direction of a designated educational supervisor and OMSB Specialty Committee. Trainees are required to keep a training record detailing their training experience. Their educational supervisor, the consultant in charge of training, will inspect this on a regular basis. Trainees will be regularly informed of their progress and, in addition, must be encouraged and given every opportunity to discuss any deficiencies in the training programme. Trainees should agree a training programme (formal educational contract) with their supervisor soon after appointment. Work place based learning is unpredictable but enhances skills, efficiency and problem solving. The trainee should have a formative /supportive appraisal at least twice a year. At this informal meeting involving the educational supervisor and trainee, the educational supervisor should sign the training record and plan forthcoming training needs. Educational supervisors would be expected to have substantial experience in the specialty, to have demonstrated an interest in training, to have appropriate teaching resources, to be involved in the appropriate regional training committees, to be involve in the appropriate regional training committees, to be involve in annual reviews and to liaise closely with the Specialty Adviser.

GOOD MEDICAL PRACTICE CURRICULUM FOR CLINICAL BIOCHEMISTRY

This section outlines the generic knowledge, skills and attitudes that are tailored to and required for specialist training in clinical biochemistry and the competencies acquired in relation to the practice of clinical biochemistry. It is intended that trainees follow this curriculum for their entire training period in clinical biochemistry. This section will be complemented by training and courses organized by the local Deanery holding the trainee. It is the responsibility of the educational supervisor to liaise with the local Programme Director and Executive President of the OMSB (Oman Medical Specialty Board) to ensure that the trainee has access to the necessary training opportunities, including attendance at courses to enable them to acquire the competencies as outlined in this curriculum.

1. GOOD CLINICAL CARE

Objective: to demonstrate adequate knowledge and skills and appropriate attitudes in routine clinical work.

New specialists will:

- have the breadth of knowledge and skills to take responsibility for safe clinical decisions.
- have the self-awareness to acknowledge where the limits of their competence lie and when it is appropriate to refer to other senior colleagues for advice.
- have the potential (or the ability) to take responsibility for clinical governance activities, risk management and audit in order to improve the quality of service provision.

Subject	Knowledge	Skills and knowledge application	Attitudes
Patient medical (or clinical) history	Define the patterns of symptoms found in patients presenting with metabolic/biochemical disease.	<p>Be able to take and analyze a clinical history in a relevant succinct and logical manner.</p> <p>Be able to overcome difficulties of language, physical and mental impairment.</p> <p>Use interpreters and advocates appropriately.</p>	<p>Show empathy with patients.</p> <p>Appreciate the importance of psychological factors for patients and relatives.</p> <p>Appreciate the interaction of social factors and the patient's illness.</p>
Examination	<p>Define the biochemistry basis of physical signs.</p> <p>Define the clinical signs found in diseases.</p>	Be able to perform a reliable and appropriate examination.	<p>Respect patients' dignity and confidentiality.</p> <p>Acknowledge cultural issues.</p>

			Appropriately involve relatives. Appreciate the need for a chaperone
Investigations including imaging	<p>Define the biochemistry basis of investigations.</p> <p>Define the indications for investigations.</p> <p>Define the risks and benefits of investigations.</p> <p>Know the clinical and cost effectiveness of individual investigation.</p>	<p>Be able to interpret the results of investigations.</p> <p>Be able to perform appropriate clinical investigations competently where relevant.</p> <p>Be able to liaise and discuss investigations with colleagues and to advise them appropriately.</p>	<p>Understand the importance of working with other healthcare professionals and team-working.</p> <p>Show a willingness to provide explanation to patient as to rationale for investigations, and possible unwanted effects.</p>
Treatment (therapeutics)	<p>Explain the scientific theory relating to pharmacology and the biochemistry of therapeutic interventions metabolic/biochemical diseases.</p>	<p>Be able to accurately assess the patient's needs.</p>	<p>Clearly and openly explain treatments and side effects of drugs.</p>
Note-keeping, letters, etc	<p>Know how to write summaries, letters, medico-legal reports.</p> <p>Define the structure, function and legal implications of medical records and medico-legal reports.</p> <p>Know the relevance of the data protection pertaining to patient confidentiality.</p>	<p>Record concisely, accurately, confidentially and legibly the appropriate elements of the history, examination, results of investigations, differential diagnosis and management plan.</p> <p>Be able to write summaries, letters, medico-legal reports.</p> <p>Date and sign all records.</p>	<p>Appreciate the importance of timely dictation, cost effective use of medical secretaries and the growing use of electronic communication.</p> <p>Be aware of the need for prompt and accurate communication with primary care, other agencies and patients or their families.</p> <p>Show courtesy towards medical secretaries and clerical staff.</p>

Management of chronic disease	Define the clinical presentation and natural history of patients with chronic disease.	Maintain hope whilst setting long term realistic goals. Develop long-term management plans for relevant chronic disease.	Treating each patient as an individual. Appreciate the effects of chronic disease states on patients and their relatives. Appreciate the importance of cooperation with primary care.
Time-management	Know which patients /tasks take priority.	Start with the most important tasks. Work more efficiently as clinical skills develop. Recognize when he/she is falling behind and re-prioritize or call for help.	Have realistic expectations of tasks to be completed by self and others. Willingness to consult and work as part of a team.
Decision making	Understand clinical priorities for investigation and management	Analyze and advise on clinical problems related to biochemical/metabolic diseases.	Be flexible and willing to change in the light of changing conditions. Be willing to ask for help

2. MAINTAINING GOOD MEDICAL PRACTICE

Objective: to keep knowledge and skills and appropriate attitudes up to date.

New specialists will:

- take responsibility for and keep up-to-date in their own relevant professional and self-development, and facilitate that of others
- acknowledge that the balance of their skills and expertise will change as their careers progress and they specialize in certain areas of clinical practice.

Subject	Knowledge	Skills and knowledge application	Attitudes
Overall clinical judgment	Possess sufficient clinical and biochemical knowledge to enable integration of clinical and laboratory features.	Correct interpretation of test results in the context of available clinical information.	Critical appraisal of the available clinical and laboratory data in coming to diagnostic/treatment decisions.

Recognise own limitations	Know the extent of one's own limitations and know when to ask for advice.		Be willing to consult and to admit mistakes.
Written records	<p>Possess knowledge of the appropriate content of clinical records.</p> <p>Understand the problems faced by people with educational and/or physical disabilities.</p> <p>Know the relevance of data protection pertaining to patient confidentiality.</p>	Produce accurate letters/reports and other written correspondence with clear conclusions.	<p>Appreciate the importance of timely dictation, cost-effective use of medical secretaries and the growing use of electronic communication.</p> <p>Be aware of the need for prompt and accurate communication with clinicians and patients and their families.</p> <p>Show courtesy towards medical secretaries and clerical staff.</p>
Decision making	Understand clinical priorities for investigation and management.	Analyze clinical and laboratory problems effectively.	<p>Be flexible and willing to change in the light of changing conditions.</p> <p>Be willing to ask for help</p>
Life-long learning	Understand the importance of continuing professional development.	<p>Recognize and use learning opportunities.</p> <p>Use the potential of study leave to keep one up to date.</p> <p>Able to maintain a professional portfolio.</p> <p>Monitor own performance through audit and feedback.</p>	<p>Be self-motivated and eager to learn.</p> <p>Show willingness to learn from colleagues and to accept constructive feedback.</p>
Good use of information technology (IT)	<p>Understand use of email, internet, fax and the telephone.</p> <p>Know the principles of how to retrieve and utilize data recorded in clinical systems.</p>	<p>Demonstrate competent use of database, word processing and statistics programmes.</p> <p>Be able to undertake searches (including literature searches) and</p>	<p>Demonstrate the acquisition of new attitudes in patient consultation in order to make maximum use of IT.</p> <p>Demonstrate appropriate techniques to be able to</p>

	<p>Know the principles of literature searching using medical databases.</p> <p>Demonstrate an understanding of the range of possible uses for clinical data and information and appreciate the dangers and benefits of aggregating clinical data.</p> <p>Define the main features, responsibilities and liabilities pertaining to confidentiality.</p>	<p>access websites and health related databases.</p> <p>Apply the principles of confidentiality in the context of IT.</p>	<p>share information on computer with the patient in a constructive manner.</p> <p>Adopt proactive and enquiring attitude to new technology</p>
<p>The organizational framework for clinical governance and its application in practice</p>	<p>Possess an understanding of the important aspects of clinical governance:</p> <ul style="list-style-type: none"> • medical and clinical audit • research and development • integrated care pathways • evidence-based practice • clinical effectiveness • clinical risk systems • to define procedures and effective action when things go wrong in one's own practice or that of others • complaints procedures • risk assessments <p>Understand the benefits a patient might reasonably expect from clinical governance.</p>	<p>Be an active participant in clinical governance.</p> <p>Be able to undertake medical and clinical audit.</p> <p>Be actively involved in audit cycles.</p> <p>Be active in research and development.</p> <p>Critically appraise medical data research.</p> <p>Practice evidence-based medicine.</p> <p>Aim for clinical effectiveness (best practice) at all times.</p> <p>Educate self, colleagues and other healthcare professionals.</p> <p>Be able to handle and</p>	<p>Make the care of your patient your first concern.</p> <p>Respect patients' privacy, dignity and confidentiality.</p> <p>Be prepared to learn from mistakes, errors and complaints.</p> <p>Recognize the importance of team work.</p> <p>Share best practice with others</p>

		deal with complaints in a focused and constructive manner. Learn from complaints.	
The organizational framework for clinical governance and its application in practice (continued)		Report critical incidents. Take appropriate action if you suspect you or a colleague may not be fit to practice. Develop and institute clinical guidelines and integrated career pathways.	Display a keenness to use evidence in the support of patient care and own decisions therein.
Risk management	Possess knowledge of such matters as health and safety policy, policies on needle stick injuries, note keeping, communications and staffing numbers. Possess knowledge of risk management issues pertinent to laboratory processing. Possess knowledge of risk assessment, perception and relative risk. Know the complications and side effects of treatments and investigations.	Confidently and authoritatively discuss relevant risks with patients and to obtain informed consent. Able to balance risks and benefits with patients.	Willingness to respect and accept patients' views and choices. Willingness to be truthful and to admit error to patients, relatives and colleagues.
Evidence	Know and understand: <ul style="list-style-type: none"> • the principles of evidence-based medicine • the types of clinical trial • the types of evidence 	Ability to critically appraise evidence. Ability to be competent in the use of databases, libraries and the internet. Ability to discuss the relevance of evidence	

		with individual patients or their families.	
Clinical audit	<p>Know and understand the audit cycle, data sources and data confidentiality.</p> <p>Understand the principles of internal and external quality assurance</p>	<p>Involvement in ongoing audit.</p> <p>Complete at least one clinical audit project per year</p>	<p>Consider the relevance of clinical audit to benefit patient care and individual performance (i.e. to clinical governance).</p>
Guidelines	<p>Know the advantages and disadvantages of guidelines</p>	<p>Demonstrate the ability to utilize guidelines.</p> <p>Be able to contribute to the evolution of guidelines</p>	<p>Show regard for individual patient needs when using guidelines.</p> <p>Show willingness to use guidelines as appropriate.</p>
Structure of the NHS and the principles of management	<p>Know the structure of the Health Service, primary care groups and hospital trusts.</p> <p>Know the local Trust's management structure (including chief executives, medical directors, clinical directors and the pathology laboratory).</p> <p>Know finance issues in general in the NHS, especially budgetary management and commissioning</p> <p>Understand the importance of a health service for the population.</p>	<p>Develop skills in managing change and managing people.</p> <p>Develop interviewing techniques and those required for performance reviews.</p> <p>Be able to build a business plan.</p> <p>Be able to utilize one's position in the NHS to best effect</p>	<p>Show an awareness of equity in healthcare access and delivery.</p> <p>Demonstrate an understanding of the importance of a health service for the population.</p> <p>Show respect for others, ensuring equal opportunities.</p>

3. TEACHING AND TRAINING, APPRAISING AND ASSESSING

Objective: to demonstrate the knowledge, skills and attitudes to provide appropriate teaching and to participate in effective research.

New specialists will:

- be able to demonstrate the potential to teach and train effectively at all levels of undergraduate and postgraduate education where required.
- demonstrate skills and strategies in the process of feedback to colleagues and trainees, ensuring positive and constructive outcomes.
- be capable of judging competence and professional attributes in others.

Subject	Knowledge	Skills and knowledge application	Attitudes
To have the skills, attitudes and practices of a competent teacher	Identify adult learning principles. Identify learner needs. Structure of a teaching activity. Varied teaching strategies. Identify learning styles. Principles of evaluation.	Facilitate learning process. Identify learning outcomes. Construct educational objectives. Design and deliver an effective teaching event. Communicate effectively with the learners. Use effective questioning techniques. Teach large and small groups effectively. Select and use appropriate teaching resources. Give constructive effective feedback. Evaluate programmes and events. Use different media for teaching that are appropriate to the	Demonstrate a willingness and enthusiasm to teach. Show respect for the learner. Demonstrate a professional attitude towards teaching. Show commitment to teach. Demonstrate a learner centered approach to teaching.

		teaching setting	
To be able to plan and analyze a research project	<p>Know the principles of performing a research study.</p> <p>Know how to use appropriate statistical methods.</p> <p>Know the principles of research ethics and the structure and function of local research ethics committees.</p> <p>Know how to write a scientific paper.</p> <p>Understand principles of research funding and how to obtain funding</p>	<p>Undertake systematic critical review of scientific literature.</p> <p>Ability to frame questions to be answered by a research project.</p> <p>Develop protocols and methods for research.</p> <p>Be able to use databases.</p> <p>Be able to accurately analyze data.</p> <p>Be able to write a scientific paper.</p> <p>Have good written and verbal presentation skills.</p>	<p>Demonstrate curiosity and a critical spirit of enquiry.</p> <p>Ensure patient confidentiality.</p> <p>Demonstrate knowledge of the importance of ethical approval and patient consent for clinical research.</p> <p>Humility.</p>
Appraisal and assessment	<p>Understand the concepts of appraisal and assessment.</p> <p>Understand how to conduct an appraisal interview/ assessment.</p>	<p>Able to maintain an appraisal portfolio.</p> <p>Develop the ability to undertake an effective appraisal or assessment.</p>	<p>Demonstrate a positive attitude to appraisal.</p> <p>Be aware of equality and diversity issues as they relate to appraisal.</p>

4. RELATIONSHIP WITH PATIENTS

Objective: to ensure that the trainee has the knowledge, skills and attitudes to act in a professional manner at all times.

New specialists will:

- be skilled in building relationships of trust with patients and their families, through effective interpersonal skills, a courteous and compassionate approach, and respect for their privacy, dignity and cultural and religious beliefs.
- follow the principles and legal aspects of consent and confidentiality.
- be able to manage difficult and complex situations with patients and their families, to advise them appropriately and to manage complaints effectively.

Subject	Knowledge	Skills and knowledge application	Attitudes
Patient safety	Understand the issues around patient safety. Reporting and Learning System	Demonstrate awareness of patient safety in a practical situation.	Show regard for patient safety.
Continuity of care	Understand the relevance of continuity of care.	Ensure satisfactory completion of reasonable tasks at the end of the shift/day with appropriate handover. Ensure appropriate documentation of/for handover. Make adequate arrangements to cover leave.	Recognize the importance of punctuality and attention to detail. Recognize importance of communication with patients/care
Informed consent	Know the process for gaining informed consent. Understand the principles of consent issues as relating to clinical practice and research. Know how to gain consent for a research project	Give appropriate information in a manner patients understand and be able to gain informed consent from patients. Demonstrate appropriate use of written material.	Respect for patients' and relatives' points of view and wishes. Consider the patient's needs as an individual.
Confidentiality	Be aware of relevant strategies to ensure confidentiality. Be aware of situations when confidentiality might be broken	Use and share all information appropriately. Avoid discussing one patient in front of another. Be prepared to seek patient's wishes before disclosing information.	Respect the right to confidentiality
Within a consultation	Know how to structure the interview to identify the patient's: • concerns/problem	Listen. Use 'open' questions followed by appropriate	Demonstrate an understanding of the need for: • involving patients in

	<p>list/priorities</p> <ul style="list-style-type: none"> • expectations • understanding • acceptance. 	<p>‘closed’ questions.</p> <p>Give clear information and feedback to patients and share information with relatives when appropriate</p> <p>Reassure ‘worried well’ patients.</p>	<p>decisions</p> <ul style="list-style-type: none"> • offering choices • respecting patients views • dress and appearance that is appropriate to the clinical situation and patient
Breaking bad news	<p>Know how to structure the interview and where it should take place.</p> <p>Be aware of the normal bereavement process and behavior.</p> <p>Have awareness of organ donation procedures and role of local transplant coordinators.</p>	<p>Be able to break bad news in steps appropriate to the understanding of the individual and be able to support distress.</p> <p>Maintain appropriate hope whilst avoiding inappropriate optimism</p>	<p>Act with empathy, honesty and sensitivity.</p>
Complaints	<p>Have awareness of the local complaints procedures.</p> <p>Have an awareness of systems of independent review.</p>	<p>Manage dissatisfied patients/relatives.</p> <p>Anticipate potential problems.</p>	<p>Act promptly and with honesty and sensitivity.</p> <p>Be prepared to accept responsibility.</p>
Doctor-patient relationship	<p>Understand all aspects of a professional relationship.</p> <p>Establish the limiting boundaries surrounding the consultation.</p> <p>Deal with challenging behavior in patients that transgress those boundaries, e.g. aggression, violence, racism and sexual harassment.</p>	<p>Help the patient appreciate the importance of cooperation between patient and doctor.</p> <p>Develop the relationship that facilitates solutions to patient’s problems.</p> <p>Deal appropriately with behavior falling outside the boundary of the agreed doctor-patient relationship in patients, e.g. aggression, violence, sexual harassment.</p>	<p>Adopt a non-discriminatory attitude to all patients and recognize their needs as individuals.</p> <p>Seek to identify the healthcare belief of the patient.</p> <p>Acknowledge patient rights to accept or reject advice.</p>

<p>Educating patients about</p> <ul style="list-style-type: none"> -disease -investigations -therapy 	<p>Know investigation procedures including possible alternatives and choices.</p> <p>Be aware of strategies to improve adherence to therapies.</p>	<p>Give information to patients clearly in a manner that they can understand, including written information.</p> <p>Encourage questions. Negotiate individual treatment plans including action to be taken if patient deteriorates or improves.</p>	<p>Consider involving patients in developing mutually acceptable investigation plans.</p> <p>Encourage patients to access:</p> <ul style="list-style-type: none"> • further information • patient support groups
<p>Environmental and lifestyle risk factors</p>	<p>Understand the risk factors for disease including:</p> <ul style="list-style-type: none"> • diet • exercise • social deprivation • occupation • substance abuse • behavior. 	<p>Advise on lifestyle changes.</p> <p>Involve other healthcare workers as appropriate.</p>	<p>Suppress any display of personal judgment</p>
<p>Epidemiology and screening</p>	<p>Know the methods of data collection and their limitations. Know diseases that are notifiable.</p> <p>Know principles of primary and secondary prevention and screening</p>	<p>Assess an individual patient's risk factors.</p> <p>Encourage participation in appropriate disease prevention or screening programmes.</p>	<p>Consider the:</p> <ul style="list-style-type: none"> • positive and negative aspects of prevention • importance of patient confidentiality. <p>Respect patient choice.</p>

5. WORKING WITH COLLEAGUES

Objective: to demonstrate good working relationships with colleagues and appropriate communication skills.

New specialists will:

- strive for continuing improvement in all aspects of their work and that of colleagues while mindful of priorities and high standards
- have effective interpersonal skills which enable them to bring out the best in colleagues, to resolve conflicts when they arise and to develop working relationships within the team
- Support teams that bring together different professions and disciplines and other agencies, to provide high quality healthcare.

Subject	Knowledge	Skills and knowledge application	Attitudes
Clinical teams	<p>Understand how a team works.</p> <p>Understand the roles and responsibilities of team members, especially within the department and within multidisciplinary teams.</p> <p>Know how a team works effectively.</p> <p>Know the roles of other clinical specialties and their limitations</p>	<p>Be able to communicate effectively and seek advice if unsure.</p> <p>Recognize when input from another specialty is required for individual patients.</p> <p>Be able to work effectively with other health care professionals.</p> <p>Respect skills and contribution of colleagues.</p> <p>Recognize own limitations.</p> <p>Recognize when to delegate.</p> <p>Show leadership and supervise safely.</p>	<p>Show respect for others opinions.</p> <p>Respect colleagues, including non-medical professionals and recognize good advice.</p> <p>Recognise own limitations.</p>
Communication with colleagues	<p>Know:</p> <ul style="list-style-type: none"> • how to communicate with other members of the pathology department, other departments and other members of the multidisciplinary team • how to communicate in writing, through letters and reports • when to phone a General Practitioner (GP). 	<p>Use appropriate language.</p> <p>Select an appropriate communication method.</p>	<p>Be prompt and respond courteously and fairly.</p>

Complaints	Have awareness of the local complaints procedures. Have an awareness of systems of independent review	Anticipate potential problems. Manage dissatisfied colleagues	Act with honesty and sensitivity and promptly. Be prepared to accept responsibility.
Interactions between: <ul style="list-style-type: none"> • hospital and GP • hospital and other agencies, e.g. social services • medical and surgical specialties 	Know the roles and responsibilities of team members. Know how a team works effectively. Know the roles of other clinical specialties and their limitations.	Delegate, show leadership and supervise safely Be able to communicate effectively. Handover safely. Seek advice if unsure. Recognize when input from another specialty is required for individual patients. Be able to work effectively with GPs, other medical and surgical specialists and other healthcare professionals.	Show respect for others opinions. Be conscientious and work cooperatively. Respect colleagues, including non-medical professionals and recognize good advice. Recognize own limitations
Creating an environment in which mistakes and mismanagement of patients can be openly discussed and lessons learned		Be aware of the advantages and disadvantages of guidelines. Report and investigate critical incidents. Take appropriate action if you suspect you or a colleague may not be fit to practice.	

6. HEALTH

Objective: to understand the importance of the personal health of the doctor.

New specialists will:

- act quickly and effectively if they have reason to believe that their own or a colleague's conduct, performance or health may put patients at risk.

Subject	Knowledge	Skills and knowledge application	Attitudes
Personal health	Know of occupational health services. Know of one's responsibilities to the public. Know not to treat oneself or one's family.	Recognise when personal health takes priority over work pressures and to be able to take the necessary time off.	Recognise personal health as an important issue.
Stress	Know the effects of stress. Have knowledge of support facilities for doctors.	Develop appropriate coping mechanisms for stress and ability to seek help if appropriate.	Recognise the manifestations of stress on self and others.

7. PROBITY

Objective: to be able to demonstrate probity in all aspects of professional practice.

New specialists will:

- always act in their personal and professional lives to maintain public trust in the profession
- undertake duties such as writing reports, giving evidence and completing and signing documents in a timely, honest and conscientious way
- through their leadership encourage the development and practice of these qualities in their colleagues.

Subject	Knowledge	Skills and knowledge application	Attitudes
Service information	Legal framework for advertisements		Recognise absolute importance of accuracy and impartiality
Writing reports and giving evidence			Honesty and integrity. Timeliness.
Research		Obtain ethical approval	Put safety and care of patients first. Conduct research with honesty and integrity.
Financial dealings			Not induce patients to accept private medical care. Manage funds for the purpose for which they are intended. Declare conflicts of interest

CORE CLINICAL BIOCHEMISTRY CURRICULUM (STAGE A : R1, R2 and R3)

INTRODUCTION

The following core clinical biochemistry curriculum has been adopted from the Royal College of Pathologists, UK. This curriculum indicates the level of theoretical knowledge, and clinical and laboratory skills which might reasonably be expected to be achieved by a trainee during their first stage of training in clinical biochemistry. This list is not intended to be prescriptive, since the clinical and laboratory workloads of training departments will differ, and it may well be that certain elements cannot be accommodated during the first year of training. The curriculum nonetheless defines those parts of the whole curriculum to which attention should principally be paid for R1, R2 and R3 levels. In brief, trainees would be expected to acquire the following skills:

- knowledge of laboratory techniques that underpin clinical laboratory practice
- gained knowledge of laboratory practice including health and safety and quality assurance
- a basic knowledge of the presentation, differential diagnosis and natural history of the common chemical biochemistry disorders
- sufficient understanding of chemical biochemistry to offer basic advice on the interpretation of laboratory results.

1. LABORATORY COMPETENCIES

Introduction to clinical biochemistry

Objective: to achieve sufficient knowledge of laboratory clinical biochemistry to offer basic advice on the interpretation of results.

Knowledge	Skills and knowledge application	Attitudes
Operation of automated analyzers	Understand the principles of the operation of automated analyzers. Interpretation of results generated. Identification of invalid results.	
Knowledge of specimen collection, handling, transport and sample storage Understanding the use of specific preservatives and possible interference in assays	Familiar with the functions of pathology reception, the phlebotomy service. Comprehending the problems associated with 24 hour urine collections.	

Principles of health and safety		Application to the working laboratory and avoiding risks.
IT and communication skills	Familiar with fundamental aspects of computing within the laboratory, databases, spreadsheets, internet. Use on a day-to-day basis.	Proactive attitude to new technology
Principles of quality control and assurance	Basic understanding of quality control and quality assurance. Understanding the use of External Quality Assurance (EQA) and National External Quality Assurance Service (NEQAS) Evaluation of internal/external quality assurance data so as to identify the possible cause of aberrant data.	Applies principles to laboratory
Presentation, diagnosis and management of common chemical pathology disorders	Recognise the biochemical/metabolic features of diseases and their abnormal findings in the laboratory. Advise on the differential diagnosis and initial management of common chemical pathology disorders. Supervised participation in duty biochemist rota. Be aware of the need to consult about results that are not understandable.	Works as part of the clinical team. Relates laboratory results to patient care. Understanding the role of other specialties

Analytical Techniques and Instrumentation

Objective: To become competent analyst in a range of analytical techniques, their performance, comparative usefulness and applications so as to be competent in the management of the clinical biochemistry laboratory.

Subject	Knowledge	Skills and knowledge application	Attitudes
Basic laboratory techniques and centrifugation	Methods of standardization and calibration. Identification of common method interferences.	Experience of techniques, and conversant with the performance and limitations of widely	Establishes close rapport and understanding with laboratory staff working as part of a

	<p>Use of pipettes.</p> <p>Preparation and storage of reagents.</p> <p>Use and maintenance of centrifuges</p>	<p>used methods in clinical biochemistry.</p> <p>To detect errors and sources of error.</p> <p>Taking responsibility for assays.</p> <p>Ensuring analytical competence</p>	<p>multidisciplinary team.</p> <p>Learning experience with all laboratory staff.</p> <p>Ensure liaison between laboratory and clinical staff.</p>
Assay interference	<p>Understands the mechanisms by which common interferences affect laboratory assays (haemolysis, jaundice, lipaemia).</p> <p>Heterophilic antibodies.</p>	<p>Practical experience of investigating assay interference.</p>	<p>Laboratory problems create learning opportunities</p>
Automated instrumentation	<p>Random access, immunoassay analyzers robotics and modular systems.</p>	<p>Understand the technology and design of biochemistry analyzers and appreciate their limitations and benefits.</p>	
Spectrometric methods	<p>Spectrometry: visible, Ultra-violet (UV),</p> <p>Turbidimetry,</p>	<p>Experience of the application of some of these methods.</p>	
Osmometry	<p>Principle of technique</p>	<p>Experience of use of technique.</p>	
Electrometric methods	<p>Ion selective electrodes Na⁺, K⁺, H⁺, pO₂, pCO₂, Ca²⁺,</p>	<p>Experience of the application of some of these methods.</p>	
Enzymology	<p>Fixed interval, kinetic assays, isoenzymes, enzymes as reagents</p>	<p>Experience of the application of some of these methods.</p>	
Immunochemical techniques	<p>Immuno -assay, -metric.</p> <p>Labels enzyme, fluorimetric, and chemiluminescent.</p>	<p>Experience of the application of some of these methods</p>	

Electrophoresis	Principles of technique	Experience of the application of some of these methods.	
Chromatography	Principles of techniques	Experience of the application of some of these methods	
Point of care testing	Advantages/disadvantages of point of care testing. Glucose, Bilirubinometers, Blood gas, Ion –specific electrodes, urinalysis	Experience of the use of point of care testing in hospital.	
Solid/dry phase chemistry	Dipstick, thin film		

Evaluation of an Analytical Method

Objective: Knowledge of the processes required to establish and validate a new method.

Knowledge	Skills and knowledge application	Attitudes
Practicability Optimization of reaction conditions Recognition of critical parameters (robustness) Bias Imprecision Sensitivity Specificity Investigation of common interferences Range Criteria for acceptability	Contribute to establishing and validating a new method. Write the standard operating procedure of the method and place a copy in your portfolio	Critical attitude to assay performance

2. CLINICAL GOVERNANCE AND AUDIT COMPETENCIES

Objectives: knowledge of the lines of accountability, quality improvement programmes, clinical audit, evidence-based practice, clinical standards and guidelines, managing risk and quality assurance programmes.

Knowledge	Skills and knowledge application	Attitudes
<p>Clinical Governance Investigative Protocols Service Quality</p>	<p>Recognizing roles, responsibility and accountability.</p> <p>Participation in risk assessment.</p> <p>Monitoring/reporting adverse events.</p> <p>Availability and adherence to agreed protocols for investigations of common conditions.</p> <p>Turnaround time, complaint analysis</p>	<p>Patient care is the prime concern.</p> <p>Share best practice with others.</p> <p>Learn from mistakes and complaints.</p> <p>Maintenance of probity in clinical and laboratory practice.</p>
<p>Clinical Audit Clinical Effectiveness and audit:</p> <ul style="list-style-type: none"> • concept of systematic reviews and evidence based medicine; • role of audit in the hospital; • audit cycle; • participation in regular clinical audit, within and between departments, at the interface with primary care and at regional level. 	<p>Philosophy of clinical effectiveness: role of clinical audit in achieving this, methods of clinical audit in healthcare.</p> <p>Plan, undertake, report, and present at least one audit and undertake follow up.</p> <p>Use audit to gather evidence provided by formal review of practices and clinical performance that quality requirements and the needs of governance are being met.</p> <p>Understanding that clinical audit.</p> <p>Provides the evidence.</p> <p>Indicates change needed.</p> <p>Highlights the resources required.</p>	<p>Recognise the benefit of audit to clinical care and the multidisciplinary nature of clinical audit.</p> <p>Attendance at audit meetings in the department, other disciplines where appropriate, and possibly regional and national audit meetings.</p> <p>Taking responsibility for an audit</p>

3. COMPETENCIES IN CLINICAL BIOCHEMISTRY OF DISEASES

Objective: to relate understanding of normal human biochemistry and physiology to the clinical biochemistry of screening, diagnosis and monitoring of disease. Should be fully conversant with generic aspects.

Subject	Knowledge	Skills and knowledge application	Attitudes
Generic aspects	<p>Physiology, biochemistry, pathogenesis, pathophysiology natural history, epidemiology, presentation, diagnosis, causes, classification, complications, molecular biology, diagnostic methods required in the curriculum should be acquired throughout training.</p> <p>Biochemical, haematological and radiological techniques required for the investigations, diagnosis and screening.</p> <p>Knowledge of the pharmacology of the therapeutic agents required in management.</p> <p>Molecular biology to identify genetic disorders.</p>	<p>Advising on the appropriate use and interpretation of the results of the laboratory investigations in screening for disease, to establish (differential) diagnosis, to monitor progress and treatment.</p> <p>Liaise and communicate clearly with colleagues and other clinical teams in primary and secondary care both verbally and via clinic letters.</p>	<p>Acting as an effective interface between laboratory and clinical staff, as part of team.</p> <p>Interact effectively with members of multidisciplinary teams in hospital, GP and community.</p> <p>Recognizes the importance of good communication and supportive care for successful patient outcomes.</p> <p>Relate theoretical knowledge and laboratory results to patient management and clinical practice.</p>
Biological variability	<p>Reference values and population statistics:</p> <ul style="list-style-type: none"> • common reference intervals • inter- and intra-individual variation • assessment and application of 	<p>The effect of genetic and environmental influences such as age, sex, nutrition, time of day, stress, posture, hospitalization and therapeutic agents on biochemical results.</p>	

	biological variance data in setting analytical goals <ul style="list-style-type: none"> • assessing utility of reference values • significance of changes in serial results. 		
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4. COMPETENCIES IN THE INTERPRETATION OF LABORATORY DATA

Objectives: with supervision, ability to safely advise on the interpretation of laboratory results in diagnosis, treatment and monitoring of patients.

To attain a level of knowledge of clinical practice, giving the ability to conduct a dialogue with clinical colleagues:

- appropriate selection of tests
- interpretation of their results
- initiation of further investigation based on these results.

Subject	Knowledge	Skills and knowledge application	Attitudes
Interpretation of laboratory data	Basic biochemistry, physiology and chemical biochemistry of the disease processes under investigation in the laboratory. Nature of biochemical investigations undertaken and provided to other specialties.	Contribute competently at ward rounds and case presentations. Competent to take part in duty biochemist and reporting rota with supervision. Appropriate comments when reporting laboratory results. Critical appreciation of the role of biochemical tests. Liaison with clinical colleagues. Follow-up of abnormal investigations.	Act as part of a multidisciplinary team.

5. COMPETENCIES IN RESEARCH AND DEVELOPMENT

Objectives: critical assessment of published work and an understanding of basic statistical methods.

Knowledge	Skills and knowledge application	Attitudes
Principles of critical review	<p>Critical review and appraisal of literature.</p> <p>To assess the validity of data, experimental design and problem solving techniques.</p> <p>Implementing evidence-based clinical biochemistry.</p> <p>Using library and IT facilities</p>	Use evidence based medicine in support of patient care.
<p>Data handling and statistical methods</p> <p>Statistical interpretation of:</p> <ul style="list-style-type: none"> • laboratory and population data • standard deviation and error • median and mean • linear regression and correlation methods • methods of assessing agreement • concept of significance and related statistics • confidence intervals • non-parametric statistics • predictive value: positive and negative • specificity and sensitivity • receiver operating characteristic curves 	<p>Computer use within the laboratory: spreadsheets, databases.</p> <p>Correct analysis of results using appropriate statistical tools.</p>	Seek statistical advice before embarking on a project.

6. COMPETENCIES IN DIRECT PATIENT CARE

Generic aspects of clinical management

Objective: competent in the generic clinical and communication skills required for assessment and treatment of patients, referred for a specialist biochemical opinion, within an outpatient setting. Regular attendance at appropriate outpatient clinics under Consultant supervision is required.

Knowledge	Skills and knowledge application	Attitudes
<p>Physiology, biochemistry, pathogenesis, pathophysiology natural history, epidemiology, presentation, diagnosis, causes, classification, complications, molecular biology, diagnostic methods as set out in part in the theoretical curriculum above, which should be acquired throughout training</p>	<p>Elicit a comprehensive history including social, family and dietary aspects.</p> <p>Recognise presenting features and conduct the examination competently.</p> <p>Use appropriate investigations to establish diagnosis.</p> <p>Formulate management and treatment plans.</p> <p>Document clearly in the patient notes.</p> <p>Explain the diagnosis, treatment and side effects to the patient and relatives.</p> <p>Liaise and communicate with colleagues, teams in primary and secondary care, both verbally and in writing</p>	<p>Aware of the impact of the disorder/ diagnosis/chronic disease on the patient and family.</p> <p>Acts with empathy in communicating and managing the disorder and its complications.</p> <p>Explains planned treatment to the patient.</p> <p>Works as part of multidisciplinary team.</p> <p>Recognizes the importance of good communication and supportive care for successful patient outcomes.</p> <p>Relate theoretical knowledge and laboratory results to patient management and clinical practice.</p>
<p>Educating patients about their disease, investigations, lifestyle, treatment</p>	<p>Inform clearly both verbal and in writing.</p> <p>Advising patients about access to patient groups and information.</p>	<p>Involving patients in developing their treatment and care.</p>

CORE CLINICAL BIOCHEMISTRY CURRICULUM (STAGE B : R4 and R5)

There is no intention to use completion of this curriculum and appendices as a measure of aptitude or achievement. It is simply an indication of the range and level of experience that could be reasonably expected of trainees. The level of knowledge gained within each of the areas described below will vary between trainees. However, for each disease process listed, it is recommended that the trainee possesses at least a basic level of knowledge. A detailed curriculum for clinical and laboratory training is set out here.

1. LABORATORY COMPETENCIES

1.1. Introduction to clinical biochemistry

Objective: to achieve sufficient knowledge of laboratory clinical biochemistry to offer basic advice on the interpretation of results.

Knowledge	Skills and knowledge application	Attitudes
Operation of automated analysers	<p>Explain the principles behind automated analysers.</p> <p>Interpretation of results-generated identification of invalid results.</p>	
<p>Knowledge of specimen collection, handling, transport and sample storage</p> <p>Understanding the use of specific preservatives and possible interference in assays</p>	<p>Familiar with the functions of pathology reception, the phlebotomy service.</p> <p>Comprehending the problems associated with 24-hour urine collections.</p>	
Principles of health and safety	<p>Familiar with all aspects of health and safety in the laboratory.</p> <p>Aware of the pathologist's legal obligations.</p> <p>Clinical Biochemistry Accreditation (CPA) standards to obtain and retain full laboratory accreditation.</p> <p>The role of the Health and Safety Executive</p>	Application to the working laboratory and avoiding risks.

IT and communication skills Understanding the Data Protection Act	Familiar with fundamental aspects of computing within the laboratory, databases, spreadsheets, internet. Use on a day-to-day basis.	Proactive attitude to new technology
Principles of audit	Familiar with audit through participation in multidisciplinary clinical audit.	Recognise the benefit of audit
Principles of quality control and assurance	Full understanding of quality control and quality assurance. Understanding EQA and NEQAS The use of external NEQAS and the processing of data by these schemes. Critical evaluation of external quality assurance data so as to identify the possible cause of aberrant data, including the constraints due to instrumentation , reagents and operations.	Applies principles to laboratory
Presentation, diagnosis and management of common chemical pathology disorders	Recognise the disorder in the laboratory and advise on the differential diagnosis and initial management of common chemical biochemistry disorders. Be aware of the need to consult about results that are not understandable.	Works as part of the clinical team. Relates laboratory results to patient care. Understanding the role of other specialties.

1.2. Analytical techniques and instrumentation

Objective: to become a competent analyst with appreciation of a range of analytical techniques, their performance, comparative usefulness and applications so as to be competent in the management of the clinical biochemistry laboratory.

NB. Items in *italics* would probably not be encountered universally.

Subject	Knowledge	Skills and knowledge application	Attitudes
Basic laboratory techniques and centrifugation	<p>Methods of standardization and calibration.</p> <p>Identification of common method interferences.</p> <p>Use of pipettes.</p> <p>Preparation and storage of reagents.</p> <p>Use and maintenance of centrifuges.</p> <p>Ultra filtration.</p> <p>Ultracentrifugation</p>	<p>Wide experience of techniques, together with in depth experience of certain techniques.</p> <p>Fully conversant with the performance and limitations of widely used methods in clinical biochemistry.</p> <p>To detect errors and sources of error.</p> <p>Taking responsibility for assays.</p> <p>Ensuring analytical competence</p>	<p>Establishes close rapport and understanding with laboratory staff working as part of a multi disciplinary team.</p> <p>Learning experience with all laboratory staff.</p> <p>Ensure liaison between laboratory and clinical staff.</p> <p>Laboratory problems create learning opportunities.</p>
Assay interference	<p>Understands the mechanisms by which common interferences affect laboratory assays (haemolysis, jaundice, lipaemia).</p> <p>Heterophilic antibodies</p>	<p>Practical experience of investigating assay interference</p>	
Automated instrumentation	<p>Random access, immunoassay analysers robotics and modular systems.</p>	<p>Understand the technology and design of biochemistry analysers and appreciate their limitations and benefits.</p>	
Spectrometric methods	<p>Spectrometry: visible,UV,reflectance bichromatic, derivative, linear diode array, infra red.</p> <p>Turbidimetry,nephelometry,</p>	<p>Experience of the application of some of these methods</p>	

	<p>densitometry, fluorimetry,</p> <p>Nuclear magnetic resonance.</p> <p>Mass spectrometry</p> <p>Flame emission spectrometry.</p> <p>Atomic absorption: flame, furnace</p>		
Osmometry	Principle of technique	Experience of use of technique	
Electrometric methods	Ion selective electrodes Na ⁺ , K ⁺ , Cl ⁻ , H ⁺ , pO ₂ , pCO ₂ , Ca ²⁺ , NH ₄ ⁺ , Mg ²⁺ , Li ⁺		
Enzymology	Fixed interval, kinetic assays, isoenzymes, enzymes as reagents		
Radioisotope counting	γ- and β-counting		
Immunochemical techniques	<p>Immuno-assay, -metric assays, -electrophoresis, -fixation, -diffusion.</p> <p>Labels enzyme, fluorimetric</p>		
Electrophoresis	Cellulose acetate, Agarose, PAGE (SDS, gradient), isoelectric focusing		
Chromatography	<p>Thin layer chromatography (TLC), column, ion exchange, affinity, gas chromatography (GC), high pressure liquid chromatography (HPLC).</p> <p>Sample preparation: desalting, liquid extraction, derivitisation</p>		
Point of care testing	Glucose, bilirubinometers, blood gas, ion-specific electrodes, urinalysis, cardiac markers.	Undertake and advise on QA schemes, interdisciplinary liaison.	
Solid/dry phase chemistry	Dipstick, thin film.		
DNA/RNA/chromosomal	Analyses, PCR, Southern blotting	Interpret mutation analysis across a variety of disorders,	

		micro satellite analysis, sequencing reactions. Comprehend their application to diagnoses and family studies.	
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1.3. Evaluation of an analytical method

Objective: competence to establish and validate a new method.

Knowledge	Skills and knowledge application	Attitudes
Practicability Optimization of reaction conditions Recognition of critical parameters (robustness) Bias Imprecision Sensitivity Specificity Investigation of common Interferences Range Criteria for acceptability	Establish and validate a new method. Write the standard operating procedure of the method and place a copy in your portfolio.	Involvement in the introduction of new methods

2. LABORATORY MANAGEMENT COMPETENCIES

Objectives: to develop skills to take independent responsibility for the direction and management of the service.

Subject	Knowledge	Skills and knowledge application	Attitudes
General	<p>Request initiation, specimen transport and what contributes to error.</p> <p>Organization of the analytical and reporting process.</p> <p>Principles of successful management.</p> <p>The structure and organization of the NHS, where decision making occurs, process of change and ways of influencing decisions.</p> <p>Practical experience of business planning, finance, financial control, costing, pricing, contracting, purchasing, resource management.</p> <p>Practical aspects of personnel management, industrial relations, team building, staff training, motivation, continuing education, appraisal, dealing with problems, colleagues.</p> <p>Apply the concepts of accreditation, e.g. CPA, good laboratory practice.</p> <p>Conversant with legal requirements and Department of Health guidance.</p> <p>Multidisciplinary working patterns.</p>	<p>Formal training in reception.</p> <p>Appreciates the place of laboratory automation and IT.</p> <p>Management course training. Personnel Management including industrial relations.</p> <p>Shadowing senior departmental staff involved in business planning, writing business case, contracting, finance and resource management.</p> <p>Participation where appropriate in appointment of junior staff.</p> <p>Participation in departmental staff appraisal programme, using appraisal to developing your own skills.</p> <p>Attendance at departmental management meetings.</p> <p>Understanding mentoring and supervision relative to personal and professional development, prioritizing work, time management, delegation, planning, staff motivation</p> <p>Appreciation that compliance with CPA</p>	<p>Establishes rapport, respect and understanding with laboratory staff.</p> <p>Show respect for others' opinions.</p> <p>Recognise good advice.</p> <p>Recognise own limitations.</p> <p>Enthusiasm, integrity, imagination, determination, professional credibility.</p> <p>Aware of equity in health care access and delivery.</p>

		<p>standards ensures that training facilities are adequate.</p> <p>Undertaking accreditation review of a section of the laboratory.</p>	
Quality assurance	<p>Control the quality of a method internal quality control programmes.</p> <p>Quality control rules.</p> <p>Use of external quality assurance programmes.</p> <p>Laboratory accreditation.</p>	<p>Interpretation of quality control/quality assurance data and advise on subsequent course of action.</p> <p>Acting/assisting laboratory quality control officer and attending laboratory quality control meetings.</p> <p>Application to point of care testing</p>	
Health and safety	<p>Health and safety.</p> <p>Individual and collective responsibility.</p> <p>Handling potentially infectious samples and noxious chemicals.</p> <p>Radiation protection measures.</p> <p>Mechanical, fire and electrical safety.</p> <p>Dealing with an accident.</p> <p>Current safety guidelines</p>	<p>Attending laboratory safety committee meetings.</p>	<p>Observe safe working practices</p>
Selection of analytical equipment	<p>Specification and evaluation of an analytical system.</p> <p>Financial issues relating to analyzer installation (capital purchase, reagent rental, competitive tendering).</p>	<p>Participation in the local process.</p>	
IT	<p>The role of IT in delivery and management of service</p>	<p>IT affecting all aspects of chemical biochemistry .</p>	<p>Proactive attitude to new technology</p>

	<p>Stages in producing results and problems with turnaround time.</p> <p>Instrument interfaces.</p> <p>Links to other computers.</p> <p>Reporting/authorizations procedures.</p> <p>Patient identification and methods of ensuring accuracy.</p> <p>Management statistics.</p> <p>E-mail and intra/internet.</p> <p>Data protection act.</p> <p>Retention of records.</p> <p>Review of pathology services.</p>		
Communication skills	<p>Acquiring skills to operate with organizations, scientific and medical communities and the public.</p> <p>Principles of effective negotiation, influencing colleagues</p>	<p>Resolving technical, scientific, clinical and management problems through leadership skills and promoting morale.</p> <p>Explaining laboratory procedures to patients, their relatives and visitors.</p> <p>Working within a team, communicating with clinical, managerial and other health care staff.</p> <p>Preparing, presenting, explaining scientific reviews/data/findings, both orally and in writing.</p> <p>Understanding yourself, conflict resolution.</p>	<p>Understanding the need to involve patients, staff, and colleagues.</p> <p>Act with empathy, honesty and sensitivity.</p>

3. CLINICAL GOVERNANCE AND AUDIT COMPETENCIES

Objectives: knowledge of the lines of accountability, quality improvement programmes, clinical audit, evidence-based practice, clinical standards and guidelines, managing risk and quality assurance programmes.

Knowledge	Skills and knowledge application	Attitudes
<p>Clinical governance</p> <p>Clinical risk management</p> <p>Departmental organization</p> <p>Investigative protocols</p> <p>Service quality</p>	<p>Recognising roles, responsibility and accountability.</p> <p>Participation in risk assessment.</p> <p>Monitoring/reporting adverse events.</p> <p>Workload compared with national standards, clarity of lines of responsibility and accountability in pathology, communications within and outside the department.</p> <p>Availability and adherence to agreed protocols for investigations of common conditions.</p> <p>Turn around time, complaint analysis with lessons learnt and action taken, availability of out-of-hours service.</p>	<p>Patient care is the prime concern.</p> <p>Share best practice with others.</p> <p>Learn from mistakes and complaints.</p> <p>Maintenance of probity in clinical and laboratory practice.</p>
<p>Clinical audit</p> <p>Clinical effectiveness and audit:</p> <ul style="list-style-type: none"> • concept of systematic reviews and evidence-based medicine • role of audit in the hospital • audit cycle • participation in regular clinical audit, within and between departments, at the interface with primary care and at regional level. 	<p>Philosophy of clinical effectiveness: role of clinical audit in achieving this, methods of clinical audit in healthcare.</p> <p>Plan, undertake, report, and present audits at multidisciplinary audit meetings and the follow up</p> <p>Use audit to gather evidence provided by formal review of practices and clinical performance that quality requirements and the needs of governance are being met.</p>	<p>Recognise the benefit of audit to clinical care and the multidisciplinary nature of clinical audit. Understanding that clinical audit:</p> <ul style="list-style-type: none"> • provides the evidence • indicates change needed • highlights the resources required. <p>Attendance at audit meetings in the department, other disciplines where appropriate, and possibly regional and national audit meetings.</p>

		Taking responsibility for an audit.
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4. COMPETENCIES IN CLINICAL BIOCHEMISTRY OF DISEASES

Objective: to relate understanding of normal human biochemistry and physiology to the clinical biochemistry of screening, diagnosis and monitoring of disease.

NB. Items in *italics* would probably not be encountered universally.

Subject	Knowledge	Skills and knowledge application	Attitudes
Generic aspects	<p>Applicable to the syllabus listed below.</p> <p>Physiology, biochemistry, pathogenesis, pathophysiology, natural history, epidemiology, presentation, diagnosis, causes, classification, complications, molecular biology, diagnostic methods required in the curriculum should be acquired throughout training.</p> <p>Biochemical, haematological and radiological techniques required for the investigations, diagnosis and screening.</p> <p>Knowledge of the pharmacology of the therapeutic agents required in management.</p> <p>Molecular biology to identify genetic disorders</p>	<p>Advising on the appropriate use and interpretation of the results of the laboratory investigations in screening for disease, to establish (differential) diagnosis, to monitor progress and treatment.</p> <p>Liaise and communicate clearly with colleagues and other clinical teams in primary and secondary care both verbally and via clinic letters.</p>	<p>Acting as an effective interface between laboratory and clinical staff, as part of team.</p> <p>Interact effectively with members of multidisciplinary teams in hospital, GP and community.</p> <p>Recognises the importance of good communication and supportive care for successful patient outcomes.</p> <p>Relate theoretical knowledge and laboratory results to patient management and clinical practice.</p>
Biological variability	<p>Reference values and population statistics:</p> <ul style="list-style-type: none"> • common reference intervals • inter- and intra-individual variation • assessment and application of 	<p>The effect of genetic and environmental influences such as age, sex, nutrition, time of day, stress, posture,</p>	

	<p>biological variance data in setting analytical goals</p> <ul style="list-style-type: none"> • assessing utility of reference values ● effects of age upon reference ranges • significance of changes in serial results. 	hospitalization and therapeutic agents on biochemical results	
Gastrointestinal tract	<p>Physiology and biochemistry of digestion.</p> <p>The gut as an endocrine organ. Gastrointestinal hormones. Pathology:</p> <ul style="list-style-type: none"> • peptic ulcer disease • Zollinger Ellison syndrome • pyloric obstruction • intrinsic factor, pernicious anaemia • anaemias and haematinics (iron, iron binding capacity, ferritin, B12 and folate deficiencies) • pancreatitis (acute and chronic) • malabsorption • coeliac disease • inflammatory bowel disease • disaccharidase deficiency • intestinal obstruction • short gut syndrome • intestinal failure • gastrointestinal malignancy • carcinoid syndrome • peptide secreting tumours of the entero-pancreatic system • drain fluids • investigation of malabsorption • carbohydrate probe molecules • breath tests • investigation of chronic pancreatic dysfunction by tubeless tests • serological markers of coeliac disease. <p>Faecal analysis:</p> <ul style="list-style-type: none"> • occult blood • elastase. 		

Liver	<p>Functions of the liver.</p> <p>Formation of bilirubin.</p> <p>Enterohepatic circulation and bile salts. Jaundice: adult, children, newborn:</p> <ul style="list-style-type: none"> • familial hyperbilirubinaemias • haemolytic jaundice • intra-hepatic jaundice • obstructive jaundice. <p>Diseases of the liver:</p> <ul style="list-style-type: none"> • viral hepatitis • cirrhosis • haemochromatosis • Wilson’s disease • alcohol/drug hepatotoxicity • non-alcoholic fatty liver disease • cholestasis • biliary obstruction • gall stones and their composition • hepatoma. <p>Hepatic failure and encephalopathy.</p> <p>Liver transplantation.</p> <p>Assessment of hepatic function:</p> <ul style="list-style-type: none"> • liver function tests • prothrombin time • ammonia • alpha-fetoprotein. 		
Urogenital tract	<p>Renal physiology:</p> <ul style="list-style-type: none"> • glomerular filtration • tubular function • salt and water homeostasis • hydrogen ion homeostasis • renin, erythropoietin, vitamin D. <p>Renal disease:</p> <ul style="list-style-type: none"> • uraemia: pre, post • acute, chronic, acute-on chronic • calculi • glycosuria • tubular defects and Fanconi syndrome • metabolic disease and the kidney. 		

	<p>Normal and abnormal urine composition.</p> <p>Abnormal pigments</p> <p>Urinary deposits</p> <p>Renal stones.</p> <p>Proteinuria:</p> <ul style="list-style-type: none"> • nephrotic syndrome • differential protein clearances • tubular proteins. <p>Laboratory assessment of renal function:</p> <ul style="list-style-type: none"> • glomerular filtration rate including in vivo techniques • Modification of Diet in Renal <p>Disease (MDRD) formula</p> <ul style="list-style-type: none"> • markers of renal function • renal plasma flow • tubular function tests • protein/creatinine ratios • drug interference in urine analysis <p>Renal replacement therapy:</p> <ul style="list-style-type: none"> • haemodialysis • peritoneal dialysis • assessment of dialysis adequacy • renal transplantation • markers of transplant rejection. <p>Prostatic diseases.</p> <p>Semen analysis.</p>		
<p>Gas transport and H⁺ metabolism</p>	<p>Physiology of normal respiration, O₂, CO₂, transport, buffers.</p> <p>Respiratory and renal mechanisms in acid-base homeostasis.</p> <p>Respiratory disease.</p> <p>Causes and assessment of acid-base disturbances: measurement of H⁺, pCO₂, pO₂, satn.</p>	<p>Advise on the investigation of acid-base disorders and management.</p>	

	<p>Concept actual bicarbonate, standard bicarbonate, base excess.</p> <p>Determinants and assessment of tissue oxygenation.</p>		
Water and electrolytes	<p>Distribution of water and electrolytes.</p> <p>Turnover of body fluids.</p> <p>Regulation of extra cellular fluid, osmolality and volume:</p> <ul style="list-style-type: none"> • antidiuretic hormone • renin-angiotensin-aldosterone • natriuretic peptides. <p>Water depletion and excess.</p> <p>Hypo- and hypernatraemia.</p> <p>Hypo- and hyperkalaemia.</p> <p>Metabolic effects of trauma/surgery/stress.</p> <p>Principles of intravenous fluid therapy</p>	<p>Advise on management of fluid balance and on investigation of electrolyte disturbances</p>	
Proteins	<p>Principles of measurement.</p> <p>Properties and functions of the principal plasma proteins including:</p> <ul style="list-style-type: none"> • albumin • protease inhibitors • transport proteins • ceruloplasmin • clotting factors • complement • immunoglobulins. <p>Hypoalbuminaemia and investigation.</p> <p>Paraproteinaemias and investigation.</p> <p>Cryoglobulinaemia.</p> <p>Proteins of inflammation.</p> <p>Plasmapheresis.</p> <p>Immunoglobulin deficiencies.</p>	<p>Advise on the laboratory investigation of normality and disease.</p>	

	<p>Alpha-1-antitrypsin deficiency.</p> <p>Cytokines.</p>		
Lipids	<p>Apolipo proteins and lipid metabolism.</p> <p>Metabolic basis inherited and acquired hyper- and hypolipoproteinaemias.</p> <p>Biochemical basis for atheroma, coronary heart disease and associated risk factors.</p> <p>Patient classification: familial hypercholesterolaemia, familial combined dyslipidaemia, type III dyslipidaemia, polygenic hypercholesterolaemia, atherogenic lipoprotein phenotypes, secondary causes.</p> <p>Primary and secondary cardiovascular disease prevention.</p> <p>Laboratory investigation and principles of management of hyperlipidaemia</p>	<p>Advise on the investigation and management of hyperlipidaemia, identification of patients with secondary causes, screening family members in case of familial dyslipidaemia.</p>	
Cardiovascular system	<p>Atheroma, coronary heart disease, stroke and associated risk factors.</p> <p>Current methods of calculating risk and their shortcomings.</p> <p>Use of biochemical markers for risk stratification in acute coronary syndromes.</p> <p>Biochemical markers of myocardial damage/ventricular function.</p> <p>Hypertension (biochemical investigation and management).</p>	<p>Advise appropriately on estimation of cardiovascular risk.</p>	
Diabetes mellitus and glucose	<p>Glucose metabolism.</p> <p>Classification of diabetes.</p> <p>Diagnostic criteria: diabetes, impaired glucose tolerance (IGT),</p>	<p>Advise on the laboratory diagnosis, investigation and management.</p>	

	<p>IFG impaired fasting glucose (IFG). Pathophysiology of diabetes:</p> <ul style="list-style-type: none"> • insulin-dependant, type 1 diabetes • insulin-resistance, type 2 diabetes • secondary. <p>Complications of diabetes:</p> <p>1. Acute metabolic</p> <ul style="list-style-type: none"> • diabetic ketoacidosis • hyperosmolar non ketotic • hypoglycaemia. <p>2. Chronic:</p> <p>a. Microvascular:</p> <ul style="list-style-type: none"> • nephropathy, microalbuminuria • neuropathy and retinopathy. <p>b. Macrovascular:</p> <ul style="list-style-type: none"> • lipid abnormalities • coronary heart disease • peripheral vascular disease. <p>Principles of treatment of diabetes and monitoring of diabetic control:</p> <ul style="list-style-type: none"> • use of insulin and other pharmacological agents • dietary modification • home monitoring with meters • continuous overnight glucose monitoring. <p>Extra laboratory glucose monitoring.</p> <p>Glycated haemoglobin, insulin, C-peptide, microalbumin assays.</p> <p>Causes and laboratory investigation of hypoglycaemia in adults and children.</p>	<p>Distinguish between the various causes of diabetes</p>	
<p>Endocrinology: adult and paediatric</p>	<ul style="list-style-type: none"> • acromegaly and dwarfism • prolactinoma/macroprolactin • diabetes insipidus • dynamic function testing • isolated hormone deficiency and panhypopituitarism. <p>Adrenal cortex:</p> <ul style="list-style-type: none"> • steroid production 	<p>Interpretation and reporting on results of investigations and monitoring therapy.</p> <p>Appreciation of the role of imaging, scans.</p>	

	<ul style="list-style-type: none"> • Cushing’s syndrome • insufficiency: assessment of reserve • Conn’s syndrome • congenital adrenal; hyperplasia, diagnosis, management, intersex. <p>Adrenal medulla:</p> <ul style="list-style-type: none"> • catecholamine metabolism • phaeochromocytoma • neuroblastoma • measurement and interpretation of catecholamines and metabolites. <p>Thyroid:</p> <ul style="list-style-type: none"> • congenital hypothyroidism and screening programmes • hypo- and hyper-thyroidism • autoimmune disease, autoantibodies • adenoma/carcinoma • radioactive iodine in vivo studies • investigation and monitoring therapy • problems of interpretation: binding proteins, drug effects, sick euthyroid syndrome. <p>Medullary carcinoma of the thyroid</p> <p>Gonads:</p> <ul style="list-style-type: none"> • pituitary-gonadal axis • sexual differentiation • precocious and delayed puberty • 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 	<p>Experience of insulin, TRH, GnRH, glucagon, pituitary function, growth hormone secretion and water deprivation tests</p> <p>Experience of tests of adrenal function</p> <p>Advising on appropriate monitoring of replacement therapy.</p> <p>Ability to advise on the appropriate choice of tests to investigate and monitor thyroid disease, according to clinical circumstances.</p> <p>Ability to advise appropriately on the investigation of female androgenisation.</p> <p>Able to interpret and report on the results of investigations and monitoring therapy</p>	
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	<ul style="list-style-type: none"> • monitoring of fertility treatment. <p>Endocrine effects: cancer, ectopic hormones.</p> <p>Multiple endocrine neoplasia.</p>		
Calcium, magnesium, bone	<p>Calcium, magnesium, phosphate, parathyroid hormone (PTH) and vitamin D metabolism.</p> <p>Hyper- and hypo parathyroidism.</p> <p>Hyper and hypocalcaemia:</p> <ul style="list-style-type: none"> • calcium sensor abnormalities. <p>Hypo- and hyper-phosphataemia.</p> <p>Hypo- and hyper phosphatasaemia.</p> <p>Disorders of magnesium.</p> <p>Osteoporosis inc. steroid therapy and chronic malabsorption.</p> <p>Osteomalacia:</p> <ul style="list-style-type: none"> • renal osteodystrophy. <p>Paget's disease.</p> <p>Chemical pathology of collagen.</p> <p>Assays: calcium (total, adjusted, ionised), PTH, vitamin D, biochemical markers of bone disease.</p>	Advise on the laboratory investigation of normality and disease to establish diagnosis and monitor treatment	
Nutrition	<p>Protein-energy malnutrition.</p> <p>Markers of nutritional status.</p> <p>Effects and investigation of vitamin deficiency or excess.</p> <p>Trace element deficiency or excess.</p> <p>Principles and practical nutritional support – parenteral and enteral.</p> <p>Re-feeding syndrome.</p> <p>Biochemistry of starvation.</p> <p>Obesity: investigation, classification, risk factors,</p>	Advising on the biochemical assessment of nutritional deficiencies, treatment, appropriate clinical and laboratory monitoring of patients receiving nutritional support.	Effective participation with other professionals in a team approach to management of nutritional problems.

	<p>complications.</p> <p>Nutritional management of disease malnutrition: protein-energy, disease related in:</p> <ol style="list-style-type: none"> 1. Acute disease: stroke, myocardial infarction, acute renal failure, nephrotic syndrome, acute liver failure. 2. Chronic disease: inflammatory bowel disease, coeliac disease, short bowel syndrome, cancer, gall bladder disease, malabsorption. 3. Pre- and post-op nutritional assessment, management for oesophagectomy, malignancy, major abdominal surgery. 4. Burns, multiple injury, systemic sepsis. 		
Haemoglobin and porphyrins	<p>Haemoglobin metabolism.</p> <p>Anaemia and its investigation.</p> <p>Assessment iron status.</p> <p>Detection abnormal haemoglobins: inherited and acquired.</p> <p>Metabolic basis of thalassaemia and sickle cell disease, screening.</p> <p>Red cell enzyme defects.</p> <p>Porphyria: metabolic basis, investigation, diagnosis, monitoring.</p>	Advise on the laboratory investigation of normality and disease.	
Enzymology	<p>Stability, induction</p> <p>Isoenzymes – structural basis, separation, quantitation.</p> <p>Assays:</p> <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. 	Advise on the laboratory investigation of normality and disease.	

<p>Genetics and molecular biology</p>	<p>Mode of inheritance:</p> <ul style="list-style-type: none"> • structure of nucleic acids • meiosis and mitosis • simple Mendelian and complex diseases • mitochondrial inheritance • mode of inheritance for genetic counselling, antenatal diagnosis and screening. <p>Protein synthesis:</p> <ul style="list-style-type: none"> • transcription and translation • defects in protein synthesis arising from genetic mutations. <p>Molecular pathology of single gene disorders</p> <p>Gene therapy.</p>	<p>The application of Mendelian genetics and Bayes Theorem, and the calculation of pre-and post-test probabilities in genetic counseling.</p>	
<p>Pregnancy</p>	<p>Maternal and foetal physiology, complications, detection.</p> <p>Screening: Down's syndrome, foetal malformations, neural tube defects, hydatidiform mole, choriocarcinoma, ectopic pregnancy.</p> <p>Pre-natal investigation: inborn errors.</p> <p>Monitoring phenylketonuria, diabetes, thyroid disease, liver disease.</p>	<p>Effects of pregnancy on routine biochemical tests.</p> <p>Biochemical, statistical and ethical issues surrounding antenatal screening</p>	<p>Interact effectively with medical and midwifery staff.</p>
<p>Newborn</p>	<p>Biochemical problems in the newborn:</p> <ul style="list-style-type: none"> • fluid balance • jaundice • liver disease • hypoglycaemia • calcium and phosphate homeostasis; metabolic bone disease of prematurity • hypomagnesaemia • hyperammonaemia • sweat tests • nutrition. 	<p>Factors affecting method selection and biochemical results in newborns.</p> <p>Appropriate specimen collection.</p>	

<p>Childhood</p>	<p>Hypoglycaemia.</p> <p>Calcium and phosphate disturbances.</p> <p>Hyperammonaemia.</p> <p>Reye's syndrome.</p> <p>Lactic acidosis.</p> <p>Renal disorders including Fanconi syndrome and tubular defects</p>		
<p>Inherited metabolic disorders</p>	<p>Principles of common disorders:</p> <ul style="list-style-type: none"> • Quantitative and qualitative enzyme abnormalities. • Biochemical consequences of a primary enzyme block in a metabolic pathway and the way in which clinical and pathological signs may be produced. • Detection: <ul style="list-style-type: none"> - screening: principles, methods - evaluation of detection programmes - <i>prenatal diagnosis</i>. • Methods and monitoring of treatment. • Amino acid, carbohydrate, cerebral lipidosis, fatty acid oxidation, lysosomal, metal, mitochondrial, mucopolysaccharide, organic acid, peroxisomal, purine and pyrimidine (primary and secondary), transport, urea cycle disorders. • Pre-natal investigation of the foetus. • Investigations: encephalopathy, hyperammonaemia. • Analysis: amino acids, organic acids, carnitine and acylcarnitines, enzyme assay, mucopolysaccharides, tissue culture, DNA 	<p>Trainees are not expected to have in-depth knowledge of all inherited metabolic defects but should be aware of the major categories; presentation, investigation, mechanisms of inheritance, scope of prenatal and newborn diagnosis, principles of treatment (coenzyme supplementation, enzyme inhibition, dietary manipulation).</p> <p>The effects of inborn errors on the results of routine biochemical tests.</p> <p>Advise on appropriate specimens for investigation of possible inherited metabolic disease: hyperammonaemia, hypoglycaemia.</p>	<p>Ability to collaborate with other professionals (paediatricians, nurses, dieticians) in investigation and management of patients.</p> <p>Ability to interact well with patients and relatives.</p>

		The effects of metabolic stress upon patients with inborn errors such as PKU, fatty acid oxidation defects, glycogen storage and urea cycle defects	
Neuromuscular system	<p>Formation and composition of cerebro spinal fluid (CSF). Multiple sclerosis, muscular dystrophy.</p> <p>Parkinson's disease.</p> <p>Biochemistry of psychiatric disease.</p> <p>Biochemistry of muscle disease.</p>	Use of CSF in diagnosis and monitoring disease.	
Cancer	<p>Nature of malignancy and tumour growth.</p> <p>Biochemical effects and treatment: • tumour markers: prostate, lung, breast, ovary, gastro-intestinal (GIT), pancreas, thyroid, pituitary, adrenal, neuroblastoma, hepatoblastoma, teratoma.</p>	Use of biochemical markers in diagnosis and monitoring tumours.	
Metabolic response to:	Surgery, trauma, burns, shock	Advise on biochemical investigations, monitoring and management, especially patients in ITU/HTU.	
Therapeutic drug monitoring and toxicology	<p>Pharmacokinetics, half-life, dosage prediction.</p> <p>Metabolic effects of ethanol.</p> <p>Monitoring of drug therapy, e.g: digoxin, lithium, antiepileptics, theophylline, caffeine, methotrexate, immunosuppressive, antibiotics.</p> <p>Overdose, e.g: salicylate, barbiturate, paracetamol, tri-cyclic antidepressants, benzodiazepines.</p>	<p>Appreciation of factors affecting drug action or metabolism.</p> <p>Effects of post-mortem changes on the results of laboratory investigations</p> <p>Awareness of legal procedure surrounding</p>	May require secondment to a specialist unit

	<p>Drug addiction: opiates, amphetamine, methylenedioxy-methamphetamine (MDMA), benzodiazepines, cocaine, alcohol.</p> <p>Poisoning, e.g. lead, mercury, aluminium, carbon monoxide, paraquat, iron, ethylene glycol, methanol, organophosphate compounds.</p> <p>Laboratory investigation of the unconscious and deceased patient.</p>	investigation of death	
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5. COMPETENCIES IN THE INTERPRETATION OF LABORATORY DATA

Objectives: ability to advise on the interpretation of laboratory results in diagnosis, treatment and monitoring of patients.

To attain a level of knowledge of clinical practice, giving the ability to conduct a dialogue with clinical colleagues, confidently and competently, in relation to:

- appropriate selection of tests
- interpretation of their results
- initiation of further investigation based on these results
- contribution to the construction, organization and interpretation of clinical research projects.

Subject	Knowledge	Skills and knowledge application	Attitudes
Interpretation of laboratory data	<p>Basic biochemistry, physiology and chemical biochemistry of the disease processes under investigation in the laboratory.</p> <p>Nature of biochemical investigations undertaken and provided to other specialties.</p>	<p>Contribute competently at ward rounds and case presentations.</p> <p>Competent to take part in duty biochemist and reporting rota.</p> <p>Competent in the knowledge of other diagnostic disciplines and their relevance to chemical pathology.</p> <p>Appropriate comments when reporting laboratory results.</p>	Act as part of a multidisciplinary team.

		<p>Critical appreciation of the role of biochemical tests.</p> <p>Liaison with clinical colleagues.</p> <p>Follow-up of abnormal investigations</p>	
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6. COMPETENCIES IN RESEARCH AND DEVELOPMENT

Objectives: experience in research and development to develop skills in independent and team-driven problem solving, critical assessment of published work and for gaining analytical expertise.

All trainees to undertake at least one research project during their first three years of training. The project should be consistent with the research and development programme of the laboratory or hospital and should be sufficiently novel and timely to be suitable for presentation at a scientific meeting and publication in a peer reviewed journal. Research for a higher degree, or for a dissertation for the Part 2 examination may be initiated during this period.

Knowledge	Skills and knowledge application	Attitudes
Scientific and research ability	<p>Formulate research questions and develop appropriate experimental design.</p> <p>Undertake analytically and clinically based research and/or development projects.</p> <p>Design, cost, undertake and evaluate experiments.</p> <p>Troubleshoot methods, make appropriate modifications and test for validity.</p> <p>Statistics appropriate to clinical and laboratory practice.</p> <p>Writing reports.</p> <p>Maintain an enquiring attitude.</p> <p>Obtain consent for the use of patient samples in research.</p>	<p>Maintain a questioning and critical approach to all aspects.</p> <p>Maintenance of probity in research.</p>

Principles of critical review	<p>Critical review and appraisal of literature.</p> <p>To assess the validity of data, experimental design and problem solving techniques.</p> <p>Implementing evidence-based chemical pathology.</p> <p>Using library and IT facilities.</p>	Use evidence-based medicine in support of patient care.
<p>Research presentation skills</p> <p>Produce work of publishable quality</p>	Present a poster and publish a paper in a peer reviewed journal.	
<p>Data handling and statistical methods</p> <p>Statistical interpretation of:</p> <ul style="list-style-type: none"> • laboratory and population data • standard deviation and error • median and mean • linear regression and correlation methods • methods of assessing agreement • F-test • analysis of variance • independent events • concept of significance and related statistics • t- test • confidence intervals • non-parametric statistics • predictive value: positive and negative • specificity and sensitivity • receiver operating characteristic curves • odds ratios • relative risk & chi-square tests • curve fitting routines • power calculations. 	<p>Computer use within the laboratory: spreadsheets, databases.</p> <p>Correct analysis of results using appropriate statistical tools.</p>	Seek statistical advice before embarking on a project
<p>Research and development in the NHS:</p> <ul style="list-style-type: none"> • framework and funding of 	Understanding of the processes for application for grants to support research projects.	Awareness of the opportunities for research

<p>NHS R&D</p> <ul style="list-style-type: none"> • ethical committees • hospital R&D structures • health technology assessment • project grant schemes • research councils • charitable research funding sources. 	<p>Have written at least one local research and ethics committee (LREC) submission for a project approval.</p>	
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7. COMPETENCIES IN DIRECT PATIENT CARE

7.1 Generic aspects of clinical management

Objective: competent in the generic and communication skills required for assessment and treatment of patients, referred for a specialist biochemical opinion within an outpatient setting. Trainees should be competent in at least two of the clinical modalities, and would be expected to have had at least the same clinical experience in these areas as those trainees in clinical biochemistry metabolic medicine.

Knowledge	Skills and knowledge application	Attitudes
<p>Physiology, biochemistry, pathogenesis, pathophysiology natural history, epidemiology, presentation, diagnosis, causes, classification, complications, molecular biology, diagnostic methods as set out in part in the theoretical curriculum above, which should be acquired throughout training</p> <p>Biochemical, haematological and radiological techniques required for the investigations, diagnosis and screening</p> <p>Pharmacology of the therapeutic agents required in management</p>	<p>Elicit a comprehensive history including social, family and dietary aspects.</p> <p>Recognise presenting features and conduct the examination competently.</p> <p>Use appropriate investigations to establish diagnosis.</p> <p>Formulate management and treatment plans.</p> <p>Document clearly in the patient notes.</p> <p>Explain the diagnosis, treatment and side effects to the patient and relatives.</p> <p>Breaking bad news including poor prognosis</p>	<p>Aware of the impact of the disorder/diagnosis/chronic disease on the patient and family.</p> <p>Acts with empathy in communicating and managing the disorder and its complications.</p> <p>Explains planned treatment to the patient.</p> <p>Works as part of multidisciplinary team.</p> <p>Recognises the importance of good communication and supportive care for successful patient outcomes</p> <p>Relate theoretical knowledge and laboratory results to patient management and clinical practice</p>

	<p>Liaise and communicate with colleagues, teams in primary and secondary care, both verbally and in writing.</p> <p>Role of antenatal diagnosis/family screening/molecular biology techniques in prenatal and family testing.</p>	
Principles of clinical governance, clinical risk and clinical audit including the audit cycle	<p>Involvement in ongoing audit.</p> <p>Undertake at least one audit project</p>	Recognises the benefit of audit to clinical care
Educating patients about their disease, investigations, lifestyle, treatment	<p>Inform clearly both verbal and in writing.</p> <p>Advising patients about access to patient groups and information.</p>	Involving patients in developing their treatment and care.

7.2 Calcium and metabolic bone disorders

Objective: competent to diagnose and manage patients with disorders of calcium and bone metabolism.

Knowledge	Skills and knowledge application	Attitudes
<p>Calcium, magnesium, phosphate, PTH and vitamin D metabolism</p> <p>Hyper- and hypo-parathyroidism</p> <p>Causes and investigation of hyper- and hypocalcaemia: calcium sensor abnormalities</p> <p>Hypo and hyper-phosphataemia</p> <p>Hypo- and hyper-phosphatasaemia</p> <p>Disorders of magnesium</p> <p>Osteogenesis imperfecta</p> <p>Osteomalacia</p> <p>Renal osteodystrophy</p> <p>Paget's disease of bone</p>	<p>Able to interpret bone densitometry and radioisotope scans requested.</p> <p>Able to treat and monitor bone and mineral disorders.</p> <p>Able to interpret bone densitometry and radioisotope scans requested.</p> <p>Able to treat and monitor bone and mineral disorders</p>	

<p>Osteoporosis inc. steroid therapy and chronic malabsorption</p> <p>Application, interpretation and theory of bone densitometry</p> <p>Investigation of bone turnover including biochemical bone markers</p> <p>Acute management hypercalcaemia</p>		
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7.3 Diabetes mellitus

Objective: competent to manage patients with diabetes mellitus.

Knowledge	Skills and knowledge application	Attitudes
<p>Curriculum for diabetes, lipids, cardiovascular, see above</p> <p>Diagnostic criteria for diabetes, IGT and IFG</p> <p>Principles of management of diabetic ketoacidosis, hyperosmolar non-ketotic state, hypoglycaemia</p> <p>Screening for macro- and microvascular complications by means of clinical examination and investigations</p> <p>Avoid and treatment of complications: eye disease, renal disease, hypertension, neuropathy, foot care.</p> <p>Pathophysiology of diabetic foot complications</p> <p>Practice of home monitoring inc. continuous overnight glucose monitoring</p> <p>Organisation of local diabetes service</p>	<p>Distinguish between the various causes of diabetes.</p> <p>Able to initiate treatment with appropriate hypoglycaemic agent, lipid lowering and antihypertensive drugs.</p> <p>Able to give appropriate lifestyle advice: employment, driving, diet, exercise, weight, smoking, alcohol.</p> <p>Review patients after commencement of treatment and adjust treatment as necessary to optimise glucose control and lipid profile.</p> <p>Interpret results of screening: microalbuminuria, retinal photographs.</p> <p>Able to refer.</p> <p>Advice on the avoidance of complications.</p> <p>Able to advise, interpret and discuss the use of these with</p>	<p>Working with: diabetes nurse specialists, dieticians, podiatrists, psychologists, ophthalmologists.</p>

Familiar with educational materials	patients. Organisation of an education programme to health professionals and patients.	
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7.4 Inherited metabolic disorders

Objective: competent to manage patients with inherited metabolic disorders.

Knowledge	Skills and knowledge application	Attitudes
<p>Curriculum for inherited metabolic disorders (see above) Investigation, diagnosis, treatment and management of adult patients with inborn disorders of:</p> <ul style="list-style-type: none"> •intermediary metabolism: phenylalanine, ornithine, urea cycle, branched chain amino acids, homocystine, galactose, glycogen, MMA • membrane transport: cystinuria, Fanconi syndrome, RTA, cystic fibrosis • fatty acid oxidation • lysosomal metabolism • metals: Wilson disease, haemochromatosis • mitochondrial metabolism • peroxisomal metabolism • purine and pyrimidine • previously presenting with: encephalopathy and hyperammonaemia • porphyries <p>Prenatal assessment: Down's syndrome, neural tube defects, cystic fibrosis</p>	<p>Use of specialized laboratory investigations and their interpretation.</p> <p>Use of specialized dietary interventions or treatments.</p> <p>Use of specific treatments and drugs.</p> <p>Able to counsel affected families and offer advice on prophylaxis and treatment.</p>	

7.5 Lipidology and cardiovascular risk assessment

Objective: competent to manage patients with lipids and cardiovascular risk assessment.

Knowledge	Skills and knowledge application	Attitudes
<p>Apolipo proteins, lipid metabolism, inherited and acquired hyper- and hypo-lipoproteinaemias and their metabolic basis</p> <p>Physiological basis for atheroma, coronary heart disease and associated risk factors and diseases including chronic kidney disease (CKD) and metabolic syndrome</p> <p>Classification of patients: familial hypercholesterolaemia, familial combined dyslipidaemia, type III dyslipidaemia, polygenic hypercholesterolaemia, atherogenic lipoprotein phenotypes, secondary causes primary and secondary cardiovascular disease prevention</p> <p>Current methods of calculating risk and their shortcomings</p> <p>Treatment and pharmacology to include lipid lowering, appropriate oral hypoglycaemic agents, anti-obesity and anti-hypertensive drugs.</p>	<p>Identify clinical features of genetic dyslipidaemias(xanthlasma,xanthoma-tendon, eruptive and planar, corneal arcus, lipaemia retinalis) and evidence of macro- and micro-vascular disease.</p> <p>Identify factors contributing to atherosclerosis; including diabetes, obesity, renal disease, hypertension.</p> <p>Identify patients with secondary causes.</p> <p>Classify patients.</p> <p>Give advice on the best dietary and therapeutic approach to the management of the particular form of dyslipidaemia affecting the patient.</p> <p>Aware of the need to screen and offer support to other members of the patient’s family in the case of severe familial dyslipidaemias.</p> <p>To lower blood pressure through dietary advice and drugs.</p>	

7.6 Nutrition

Objectives: competent to manage patients with nutritional disorders.

Knowledge	Skills and knowledge application	Attitudes
<p>Principles and practical nutritional support: parenteral and enteral</p> <p>Assessment and management of nutritional requirements</p> <p>Types of nutritional support, complications and their detection</p> <p>Markers of nutritional status</p> <p>Effects and investigation of vitamin and trace element excess and deficiency</p> <p>Management of patients with excess fluid/electrolyte losses</p>	<p>Assessment of nutritional status.</p> <p>Decide and prescribe nutrition support.</p> <p>Clinical and laboratory monitoring of patients receiving nutrition support.</p> <p>Avoid, detect, manage complications.</p> <p>Prescribe nutrition support and care of patients with standard and long-term total parenteral nutrition (TPN).</p> <p>Appropriate use and care of: central and peripheral feeding lines, naso gastric (NG), naso jejunal (NJ), percutaneous endoscopic gastrostomy (PEG), percutaneous endoscopic jejunostomy (PEJ) feeding tubes.</p> <p>Use of anti-emetics, GIT prokinetics.</p>	<p>Working as part of a multidisciplinary team.</p>
<p>Obesity: investigation, classification, treatment, risk factors</p> <p>Dietary and lifestyle changes</p> <p>Therapeutic agents</p> <p>Management of complications: diabetes, hypertension, hyperlipidaemia</p>	<p>Calculate BMI.</p> <p>Measure skin fold thickness, body impedance.</p> <p>Measure total body fat.</p> <p>Appropriate referral for: dietetic advice, surgical treatment</p>	<p>Understand analytical and practical limitations of the techniques</p>

<p>Malnutrition, disease-related in:</p> <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 and management for oesophagectomy, malignancy, major abdominal surgery • post trauma for burns, multiple injury, systemic sepsis. 	<p>Nutritional management of disease.</p> <p>Assess nutritional deficiencies.</p>	
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7.7 Renal stone disease

Objective: competent in the metabolic management of patients with renal stones.

Knowledge	Skills and knowledge application	Attitudes
<p>Renal stones: causes, investigations, diagnosis, treatment, pharmacology</p> <p>Appropriate follow up tests and times</p>	<p>Competent to manage patients with renal stones.</p> <p>Use of biochemical tests to investigate patients.</p> <p>Identify patients with secondary causes.</p> <p>Classify patients.</p>	

7.8 Thyroid disease

Objective: competent to manage patients with thyroid disease.

Knowledge	Skills and knowledge application	Attitudes
Theoretical curriculum for thyroid Diagnostic criteria for hypo-, hyper-thyroidism, thyroiditis, malignancy Principles of management Treatment and pharmacology Biochemical thyroid function tests Appropriate follow up tests and intervals for testing	Identify clinical features of thyroid disease. Distinguish between the various causes of thyroid disease. Initiate treatment with appropriate drug and monitor response. Sufficient first-hand experience to take clinical responsibility for such procedures. Interpretation and reporting of thyroid function tests. Good patient and nurse communication	

ACRONYMS

ACB	Association for Clinical Biochemistry
AACC	American Association of Clinical Chemistry
CCT	Certificate of Completion of Training
CKD	Chronic kidney disease
CPA	Clinical Pathology Accreditation
CPD	Continuing professional development
CSF	Cerebro spinal fluid
EQA	External quality assurance
GC	Gas chromatography
GIT	Gastro-intestinal
GP	General practitioner
HPLC	High pressure liquid chromatography
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IT	Information technology
LREC	Local research and ethics committee
MDMA	Methylenedioxy-methamphetamine
MDRD	Modification of diet in renal disease
MRCP	Membership of the Royal College of Physicians
MRCPath	Membership of the Royal College of Pathologists
MSc	Master of science
NEQAS	National External Quality Assurance Service

NG	Naso gastric
NJ	Naso jejunal
OMSB	Oman Medical Specialization Board
PCR	Polymerase chain reaction
PEG	Percutaneous endoscopic gastrostomy
PEJ	Percutaneous endoscopic jejunostomy
PTH	Parathyroid hormone
SQU	Sultan Qaboos University
TLC	Thin layer chromatography
TPN	Total parenteral nutrition
UV	Ultra-violet

Reference:

- Royal College of Pathologists, Curriculum for higher specialist training in clinical biochemistry, Joint Committee on Higher Pathology Training The Royal College of Pathologists, UK; January 2007; Website: www.rcpath.org/education