الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

Clinical Biochemistry

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بسم الله الرحمن الرحيم

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ABBREVIATIONS

Abbreviation	Description
AACC	American Association for Clinical Chemistry
ACB	Association for Clinical Biochemistry and Laboratory Medicine
ASCP	American Society for Clinical Pathology
CanMEDS	Canadian Medical Education framework
CAP	College of American Pathologists
DOPS	Direct Observation of Procedural Skills
FITER	Final In-Training Evaluation Report
GPT	General Professional Training
IFCC	International Federation for Clinical Chemistry
POCT	Point of care testing
PAGE	Polyacrylamide gel electrophoresis
RTC	Residency Training Committee
SBAMS	Scientific Board for Applied Medical Sciences
SBCB	Saudi Board for Clinical Biochemistry
SCAMS-CB	Scientific Committee for Applied Medical Sciences-Clinical Biochemistry
SCFHS	Saudi Commission for Health Specialties
SDS	Sodium dodecyl sulfate
TDM	Therapeutic Drug Monitoring

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We would also like to acknowledge that the Canadian Medical Education Directions for Specialists (CanMEDS) framework used in this curriculum is a copyright of the Royal College of Physicians and Surgeons of Canada and many of the descriptions and clinical biochemistry competencies have been acquired from their resources with permission.

WHAT IS NEW IN THIS VERSION?

The Saudi Medical Education Directions for Clinical Biochemistry (CB) training program is a competency-based curriculum that will be conducted for Four years. The curriculum competencies were adopted from different international and national frameworks in addition to the New Model of Care (MOC) that aims for successful Saudi healthcare transformation by 2030.

In this curriculum, the CanMEDS framework was adopted, as it is an

innovative, competency-based framework that describes the core knowledge, skills, and attitude of laboratory consultants. This curriculum provides a broad framework for faculty staff to focus on teaching, and for residents to focus on learning obtaining clinical experience and professional development during the training program. It is not intended to be the sole source for defining what is to be taught and learned during the residency training. Residents are expected to acquire knowledge and skills, as well as develop appropriate attitudes and behaviors throughout their training program. Above all, they are expected to take personal responsibility for their own learning.

The curriculum focuses more on shaping the future of Clinical Biochemistry Specialists by enhancing their clinical skills through more clinical exposure throughout all years in Biochemistry Lab settings. This curriculum also allows for all necessary training rotations, which can bridge the gap between knowledge and specialty skills and were clarified in newly constructed tables. The curriculum also enhances the academic activities for the residents by a mandatory release of all residents for half day per week to attend and participate in weekly academic day activities. The assessment Chapter was rewritten to include summative and formative assessment in knowledge i.e., (end-of-year progress test and a weekly academic program), skills (i.e., Practical Assignment Evaluation) and attitude (i.e., an in-training evaluation report (ITER)—based on roles and regulations of the SCFHS, in addition to summative assessment that includes part 1 and a final board examination.

INTRODUCTION

The growth in the population and the expansion in the provision of quality healthcare accompanied by an increase in the number of hospitals meant an expansion in the various laboratory facilities and services, including those catering for the Clinical Biochemistry services.

Clinical biochemistry is considered one of the major laboratory services within any healthcare providing facility. Accordingly, such an increase in laboratory services requires an equivalent growth in the number of highly qualified staff members specialized in clinical biochemistry.

Clinical chemistry (also known as chemical pathology, clinical biochemistry, or medical biochemistry) is the area of clinical pathology that analyzes body fluids. All biochemical tests come under chemical pathology. These are performed on any types of body fluids, but mostly on serum, plasma, and urine. Tests in clinical chemistry can be categorized according to their diagnostic value. These tests include (but are not limited to) the following list:

- General or routine chemistry: commonly ordered blood chemistries (e.g., liver and kidney function tests).
- Special chemistry: elaborate techniques such as electrophoresis and manual testing methods.
- Clinical endocrinology: the study of hormones and diagnosis of endocrine disorders.
- Toxicology: the study of drugs of abuse and other chemicals.
- Therapeutic Drug Monitoring: measurement of therapeutic medication levels to optimize dosage.
- Urinalysis: chemical analysis of urine for a wide array of diseases, along with other fluids such as CSF and effusions
- Fecal analysis: mostly for detection of gastrointestinal disorders.

EDUCATIONAL GOALS, OBJECTIVES, AND CLINICAL BIOCHEMISTRY COMPETENCIES

Goals and objectives

The overall objective of the program is to enroll residents in a well-structured comprehensive residency training program certified by the SCFHS in Clinical Biochemistry. After successful completion of the training and passing the final certification exam, the graduates will function as independent first specialists in this field.

- They shall be able to interpret submitted results efficiently and accurately in a timely fashion.
- They shall be competent in utilizing, whenever available, appropriate ancillary studies and finally convey their opinion in a clear and concise manner to the treating physicians.
- They must demonstrate the required knowledge, skills, and attitude for effective & safe patient-centered care and service to a diverse population. In all aspects of specialist practice, the residents must be able to address issues of gender, age, culture, ethnicity, and ethics in a professional manner.
- The purpose of this training program is to provide an adequate theoretical knowledge and practical training that is required for practicing Clinical Biochemistry Laboratory Specialty. The major

components of this program include theoretical basis of physiology and clinical biochemistry in health and disease, laboratory component, quality control, and laboratory management together with dissertation writing. Besides participating in clinically oriented mini-research projects, the residents will spend a significant amount of time in laboratory acquiring additional management skills.

The total duration of the training program is four academic years, unless the resident is exempted from part of the training by the Scientific Board for Applied Medical Sciences (SBAMS). The program recruits clinical laboratory graduates or equivalent. Upon completion of this training program and satisfying the examiners, the graduate will be granted certification from the Saudi Board in Clinical Biochemistry (SBCB), will have a degree of competency and experience considered adequate to practice Clinical Biochemistry independently, and will become eligible for the position of scientist and consultant after the requisite years of experience. They will be consultants to clinicians regarding test selection and interpretation, educators of residents and staff, researchers in developing methods and discovering biomarkers, and leaders implementing quality patient care.

Clinical biochemistry competencies

At the completion of training, the residents will have acquired the following competencies and will function effectively as per CanMEDS roles framework competencies

Medical expert	Collaborator
Technical expert	Leader
Professional	Scholar
Communicator	Health advocate

PROGRAM FRAMEWORK

General Training Requirements

- Admission into the program is in accordance with the SCFHS Training Rules and Regulations.
- Residents shall abide by the training regulations and obligations established by the SCFHS.
- Training is a full-time commitment. Residents shall be enrolled in full- time, continuous education for the entire duration of the program.
- Training is to be conducted in institutions accredited for training by the Central Accreditation Committee and the SBCB.
- Training shall be comprehensive and includes general clinical biochemistry, endocrinology, therapeutic drug monitoring, toxicology, point of care testing, and metabolic biochemistry.
- Residents shall be actively involved in working up a patient's specimen to reach a diagnosis with gradual progression of responsibility in clinical and technical aspects.

Structure of the Training Program

Table 1 summarizes the training rotation blocks throughout each year of the residency program; in addition to this, the followings are applied:

- This is a structured four-year post-graduate training program in Clinical Biochemistry (Appendix B).
- The junior years (first and second) are designed to provide training in a wide range of clinical and analytical techniques in addition to the principles of clinical biochemistry in health and disease.

- In the senior (third and fourth) years, after passing the required examinations, residents are allocated to laboratory management modules to develop different research skills.
- Residents are required to complete the allocated rotations satisfactorily for a given year and pass the end-of-year promotion exam as well as obtaining a satisfactory end of year evaluation before passing from one academic year to the next, further information on assessments and examination are available in the SCFHS Exam Rules & Regulations.
- The sequence of the rotations will be under the direction of the regional training committee.
- Each resident must be trained to be highly qualified to interpret clinical results and be involved in different technical aspects to ensure exposure to both common and uncommon conditions.
- After successful completion of all program requirements throughout the four-year training period and obtaining the Final In-Training Evaluation Report (FITER), Appendix C, candidates will receive a training completion certificate issued by the regional supervising training committee. The candidate will then be eligible to undertake the Final exam in Clinical Biochemistry after submitting the dissertation.
- Successful candidates in the “Final Certification Exam” will receive the "Saudi Board in Clinical Biochemistry" certificate.
- After successfully completing the training program and passing the Final Certification Exam, the candidate will be recognized as “First specialist in Clinical Biochemistry.” After the completion of three years of clinical practice post-certification, the candidate can apply for the position of “Consultant Clinical Scientist in Clinical Biochemistry.”

The summary of the rotation program is illustrated in Figure 2.

Program Supervision

The residency program is supervised by various layers of authorities, including the following:

Program Coordinator

The Program Coordinator is a full-time Consultant in Clinical Biochemistry & member of departmental Residency Training Committee (RTC) and has served in this capacity for a minimum of FIVE (5) YEARS. He/she must have a valid registration & classification from SCFHS and must be approved by the Scientific Board of Applied Medical Science (SBAMS) to be the program coordinator.

The program coordinator is required to:

- Maintain active involvement in the practice and research in Clinical Biochemistry.
- Pursue continuing professional development and education in Clinical Biochemistry.

Supervisor

The supervisor should be a member of the teaching staff and a full-time Consultant in Clinical Biochemistry. He/she must have a valid registration & classification from SCFHS, be approved by the RTC and SBAMS, and be able to:

- Ensure that the resident is familiar with the curriculum relevant to the year/stage of training of the program
- Ensure that the resident has appropriate day-to-day supervision appropriate to their stage of training
- Ensure that the resident is making the necessary clinical and educational progress during the training
- Ensure that the resident is aware of the assessment system and

undertakes it according to the requirements

- Act as a mentor to the resident and help with both professional and personal development
- Report the ongoing performance of the resident(s) to the program coordinator.

Training Center Board of Instructors

This committee is selected by each accredited center, with the approval of the program director & supervisor. Functions of this committee are:

- To enforce the general policy for training (selection, admission, evaluation, withdrawal, etc.) in accordance with the Rules and Regulations of SCFHS.
- To suggest program changes (if necessary) to be discussed by the department concerned, before submission to SBAMS.
- To supervise the implementation of all program regulations

The committee should meet regularly, with a minimum of two meetings each rotation: one to introduce the residents to the rotation and a second to review the performance of the residents. The program coordinator should report the performance of all residents and any further action plan, if required, to the committee with the meeting minutes.

There are other personnel involved in the administration of the program, including the following:

- Director of the regional supervisory committee (Chair of local committees)
- SBCB secretary (Coordinator)
- See Section "SCFHS policies and procedures" for more details

MINIMUM REQUIREMENTS FOR CLINICAL BIOCHEMISTRY RESIDENCY

The SCFHS requires four years of training for eligibility to appear for the Saudi Board in Clinical Biochemistry (SBCB) exam. The Saudi Board in Clinical Biochemistry is a joint program that involves rotations in different regional hospitals.

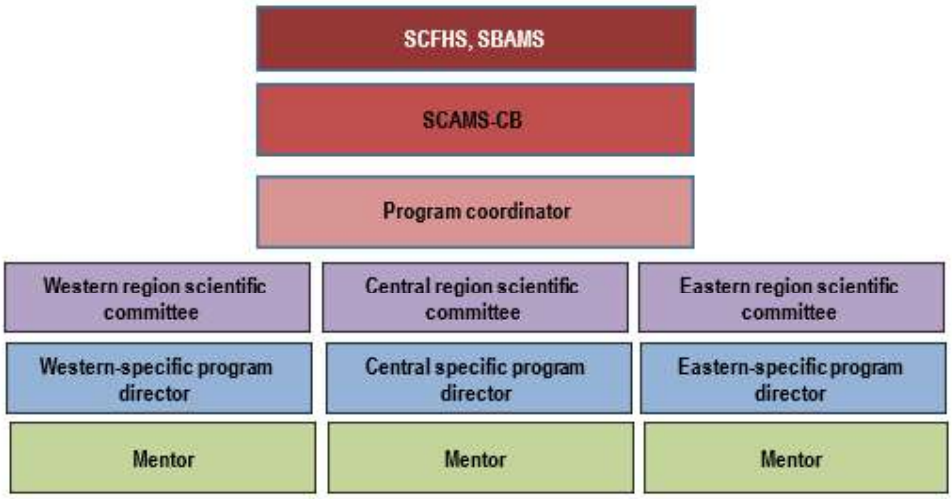
Candidates Acceptance Criteria

Applicants to this residency training should have an MSc degree in clinical chemistry or equivalent (e.g. American Board in clinical chemistry, ...etc.) and completed four years of work experience in Clinical Biochemistry. The objective is to gain experience over a wide field of Clinical Laboratory Practice. Candidates for the residency program are selected based on an interview conducted by the National and/or Regional Committee. The following are the requirements:

1) A written examination and an interview to evaluate each candidate
2) Graduate degree from appropriate and recognized college of clinical laboratory sciences and MSc degree in clinical chemistry or equivalent (e.g. American Board in clinical chemistry, ...etc.)
3) Classified as specialist by SCFHS
4) All candidates must provide a letter from a sponsoring organization, approving and pledging support for the candidate's total period of training.
5) Work experience letter (minimum four years).
6) Evidence of English exam satisfaction.

Program Organizational Structure

Figure 1: Program description



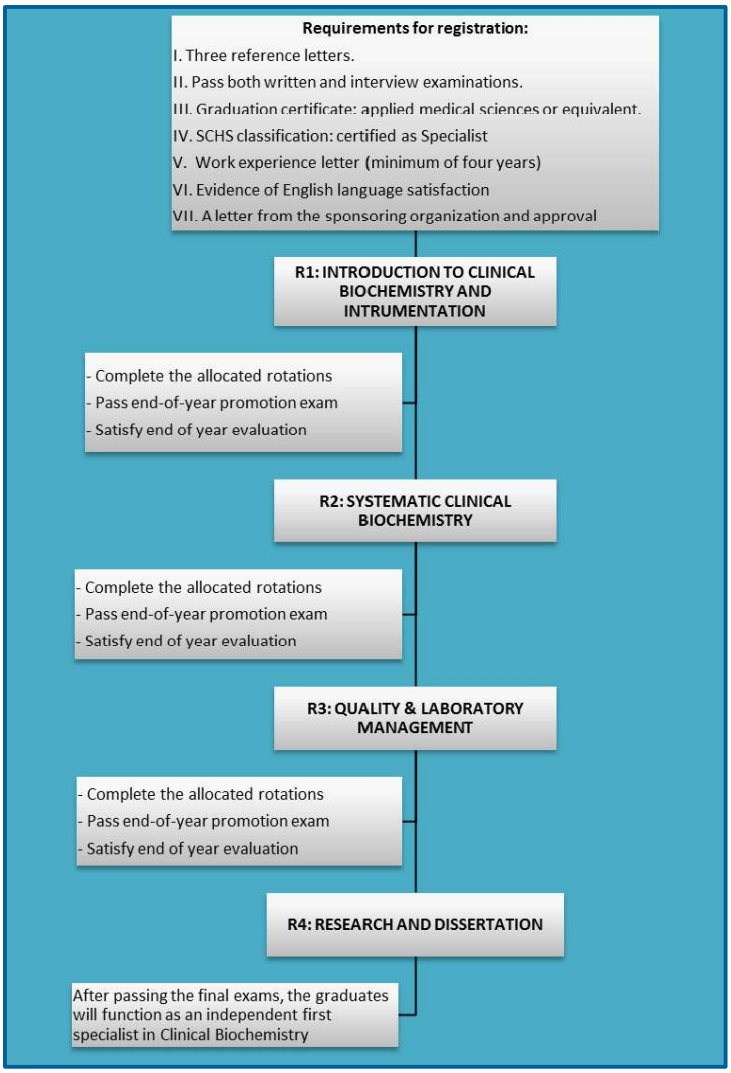
SBAMS: Scientific Board for Applied Medical Sciences. SCFHS: Saudi Commission for Health Specialists.

SCAMS-CB: Scientific Committee for Applied Medical Sciences-Clinical Biochemistry

Table 1: The summary for the training rotation blocks throughout each year of the residency program (SBCB)

R1 Pre-analytical, Analytical and Post-analytical		R2 Pathology of diseases and Result Interpretation		R3 Lab Management Inventory, Quality, Utilization, Administration, Budget and Troubleshooting		R4 Research and Ethics	
Section	Period	Section	Period	Section	Period	Section	Period
General Clinical Biochemistry	16	General Clinical Biochemistry	16	General Clinical Biochemistry	16	Project scope and design	5
						Pre-research (literature)	7
Endocrinology / Special Biochemistry	16	Endocrinology / Special Biochemistry	16	Endocrinology / Special Biochemistry	16	Research analysis	17
Point Of Care Testing	4	Point Of Care Testing	4	Point Of Care Testing	4		
Biochemical Genetics Laboratory	4	Biochemical Genetics Laboratory	4	Biochemical Genetics Laboratory	4	Post-research (thesis)	19
Toxicology	4	Toxicology	4	Toxicology	4		
Molecular Genetics	4	Molecular Genetics	4	Molecular Genetics	4		
Total	48	Total	48	Total	48	Total	48

Figure 2: Summary of the clinical biochemistry rotation program



CLINICAL BIOCHEMISTRY TRAINING ROTATIONS

R1: Introduction to clinical biochemistry and instrumentation

Course Outline

During this part of the training, the resident is expected to become a competent analyst with awareness of a wide range of analytical biochemical techniques and their performance, comparative usefulness, limitations, and applications.

Technical Competencies

Technical expert:

Become familiar with most common techniques in Clinical Biochemistry. Gain the knowledge of their principle and purpose of utilization.

This will be achieved by the following objectives:

- To demonstrate competency in the usefulness and limitations of commonly used methods in Clinical Biochemistry and be able to detect errors and their sources in biochemical assays used in the laboratory.
- To recognize the technology and design of analyzers used in Clinical Biochemistry together with their applications and limitations.

The resident should demonstrate familiarity with each of the following topics and techniques. The techniques and topics are divided into different modules, which are presented in greater detail below.

MODULES	DETAILS
Basic Laboratory Techniques and Centrifugation	✓ Specimen collection, handling, and sample storage: identification of common spectral interference ✓ Methods of standardization and calibration ✓ Use of pipettes and volumetric glassware preparation and storage of reagents ✓ Use and maintenance of centrifuges ✓ Ultracentrifugation ✓ Solvent extraction, partition coefficients ✓ Preparation of high-quality water
Photometric Methods	✓ Absorptiometry ✓ Spectrophotometry (visible/UV/reflectance) ✓ Flame spectrometry ✓ Fluorimetry ✓ Turbidimetry and Nephelometry ✓ Densitometry ✓ Bio- and chemiluminometry ✓ Atomic absorption spectrophotometry (flame/flameless) ✓ Flame Emission Spectrometry

MODULES	DETAILS
Automated Instrumentation	✓ Random access analyzers ✓ Immunoassay analyzers ✓ Centrifugal analyzers ✓ Pipetting workstations ✓ Other discrete analyzers
Electrometric Methods	✓ Ion selective electrodes (Na+, K+, Cl- ✓ pH, pO2, and pCO2, electrodes) ✓ Polarographic oxygen electrodes, e.g., glucose, other ISEs, e.g., Ca2+, NH4+, Mg2+, Li+ ✓ Titrations, potentiometric, amperometric, and conductometric methods
Osmometry	✓ Methods of measurement—for example, depression of freezing point and osmolar groups

MODULES	DETAILS
Enzymology	✓ Fixed interval assays ✓ Kinetic assays ✓ Isoenzyme fractionation/quantitation ✓ Enzyme activity ✓ Enzyme immunochemistry ✓ Enzyme-linked immunosorbent assay
Radioisotope Counting (theory)	✓ γ-counting systems ✓ β -counting systems
Immunochemical Techniques	✓ Immunoelectrophoresis ✓ Immunofixation ✓ Immunodiffusion ✓ Competitive immunoassay ✓ Immunoradiometric assay

MODULES	DETAILS
Electrophoretic and Chromatographic Techniques	✓ Cellulose acetate ✓ Agarose gel ✓ Polyacrylamide gel electrophoresis (PAGE) using sodium dodecyl sulfate (SDS) and gradient gels ✓ Isoelectric focusing ✓ Automated electrophoresis systems ✓ TLC ✓ Column chromatography (ion exchange, affinity, etc.) ✓ GC ✓ HPLC ✓ GC-MS ✓ Sample preparation (e.g., desalting, liquid extraction, derivatization) ✓ Capillary electrophoresis
Solid/Dry Phase Chemistry	✓ Dipstick technology ✓ Thin film technology

MODULES	DETAILS
DNA/RNA Analyses	✓ DNA extraction ✓ RNA extraction ✓ PCR ✓ Southern blotting
Point of Care Testing/STAT Systems	✓ All lab tests performed for patients outside the laboratory, e.g., glucometers, blood gas testing, and cardiac markers.
Laboratory Data Processing and Computing	✓ Use of computers for data collection, processing, and as management tools ✓ Expert Systems

Communicator

Communicates effectively with different levels of clinical and technical colleagues, including technicians, technologists, supervisors, clinical scientists, and consultants, verbally and in written reports.

Develops rapport, trust, and professional relationships with other sections, departments, and allied healthcare workers.

Collaborator

Works effectively with other health professionals to prevent, negotiate, and resolve inter-professional and intra-professional conflicts.

Leader

1) Leads time to maximize educational resources and opportunities.

Acquires general knowledge on how to allocate finite healthcare resources appropriately.

Serves in administrative and leadership roles, as appropriate.

Health Advocate

Knows and follows all safety precautions in the laboratory facility and strives to implement and follow all rules and regulations at all time.

Scholar

1) Maintains on-going learning. Facilitates the learning of students, junior technologists, residents, other health professionals, the public, and others, as appropriate.
2) Contributes to the growth of medical and technical knowledge by research and other scholarly activities such as teaching and dissemination of knowledge.

Professional

1) Performs and abides by the codes of ethics.
2) Demonstrates commitment to excellence and on-going professional development.

R2: Systematic clinical biochemistry

During this part of the training, the resident is expected to develop a broad knowledge of the principles of Clinical Biochemistry in health and disease in a system-based approach.

The competencies of the second year are as follows:

- To develop the basic knowledge in biochemistry, physiology, and pathology of disease processes using biochemical laboratory investigations.
- To describe the scope and value of the investigations performed in the Clinical Biochemistry Laboratory.
- To recognize the role of Clinical Biochemistry tests in studying and monitoring disease states.
- To develop the needed skills to report critical laboratory results and to communicate effectively with other clinicians.

Communicator

1) Assist in the continuing education of laboratory technologists and other members of the related staff within and outside laboratory by participating in meetings, conferences and case presentations.
2) Be part of patient management by advising clinician when needed about the
3) Indications, interpretations and clinical utility of different assays of diseases
4) Communicate with requesting physicians to advise them on the appropriate use of molecular diagnostic & cytogenetic methods.

Collaborator

1) Demonstrate the ability to advice on the appropriateness of diagnostic tests, teaching and research purposes and to advise on further additional laboratory investigations.
2) Communicate with requesting physicians to advise them on the appropriate use of additional diagnostic tests.
3) Facilitate the advice for clinicians in ordering particular tests vital for patient management

Leader

Utilize time and resources effectively to balance patient care, budget restrictions, professional expectations and personal life.

Health Advocate

As Health Advocates, the trainee should participate in promoting the health of a patient as individuals as well as communities. He/she should be able to take the opportunities for health promotion and disease prevention and try to play an active role in them.

The trainee should try to participate in various voluntary work in non-profit organizations such as (e.g. International Diabetes Day) to promote and educate the community about the importance of screening and early detection of diabetes. He /she should be familiar with the role of other methods and symptoms to screen for the disease.

Scholar

1) Contribute to the development of new knowledge through research
2) Participate in grand rounds, conferences, and teaching sessions.
3) Maintain and enhance professional activities through ongoing learning.

Professional

1) Deliver the highest quality of care with integrity, honesty and compassion.
2) Practice laboratory medicine in an ethical manner and with a sensitivity to diversity of patient results confidentiality and integrity.

Module	Details
Biological variability	Effect of genetic and environmental factors such as age, sex, nutrition, time of day, stress, posture, hospitalization, and therapeutic agents on biochemical results. — Reference values and population statistics: ○ Common reference intervals ○ Inter- and intra-individuals' variation ○ Assessment and applications of biological variance data in setting analytical goals ○ Assessing the utility of reference values ○ Significance of changes in serial results

Module	Details
Gastrointestinal tract	– Physiological and biochemistry of digestion – The gut as an endocrine organ: gastrointestinal hormones – Pathology: ○ Peptic ulcer ○ Zollinger Ellison syndrome ○ Pyloric obstruction ○ Pernicious anemia, B12 and folate deficiency ○ Pancreatitis (acute and chronic) ○ Malabsorption ○ Celiac disease ○ Inflammatory bowel disease ○ Disaccharidase deficiency ○ Intestinal obstruction ○ Short gut syndrome ○ Intestinal failure ○ Gastrointestinal malignancy ○ Carcinoid syndrome ○ Peptide secreting tumors of the entero-pancreatic system – Methods of studying gastric secretion: ○ Gastric stimulation tests using pentagastrin ○ Intrinsic factor ○ Assessment of B12 absorption – Investigation of malabsorption: ○ Carbohydrate probe molecules ○ Breath tests ○ Folate ○ Investigation of chronic pancreatic dysfunction by tubeless tests ○ Serological markers of celiac disease – Fecal analysis: ○ Occult blood ○ Fat ○ Nitrogen balance studies

Module	Details

Liver	– Functions of the liver
	– Formation of bilirubin
	– Enterohepatic circulation and bile salts
	– Jaundice in the adult:
	  ○ Familial hyperbilirubinemias
	  ○ Hemolytic jaundice
	  ○ Intra-hepatic jaundice
	  ○ Obstructive jaundice
	– Diseases of the liver:
	  ○ Viral hepatitis
	  ○ Cirrhosis
	  ○ Hemochromatosis
	  ○ Wilson's disease
	  ○ Drug hepatotoxicity, including alcohol
	  ○ Cholestasis
	  ○ Biliary obstruction
	  ○ Gall stones and their composition
	  ○ Hepatoma
	  ○ Reye's syndrome
	  ○ Hepatic failure and encephalopathy
	– Liver transplantation
	– Biochemical assessment of hepatic function/integrity:
	  ○ Liver function tests
	  ○ Prothrombin time
	  ○ Ammonia
	  ○ Alpha-fetoprotein

Module	Details

Urogenital tract:	– Renal physiology:
	  ○ Glomerular filtration
	  ○ Tubular function
	  ○ Water homeostasis
	  ○ Hydrogen ion homeostasis
	  ○ Renin-angiotensin system
	  ○ Erythropoietin
	  ○ Kallikrein-kinin system
	– Renal disease:
	  ○ Pre-renal and renal uremia and obstruction
	  ○ Acute renal failure
	  ○ Chronic renal failure
	  ○ Acute-on-chronic renal failure
	  ○ Renal calculi
	  ○ Renal glycosuria
	  ○ Fanconi syndrome and other renal tubular defects
	– Normal and abnormal urine compositions
	– Abnormal pigments
	– Urinary deposits
	– Proteinuria:
	  ○ Nephritic syndrome
	  ○ Differential protein clearances
	  ○ Tubular proteins
	– Laboratory assessment of renal function:
	  ○ Measurement of glomerular filtration rate
	  ○ Plasma markers of renal function
	  ○ Measurement of renal plasma flow
	  ○ Tubular function tests
	– Renal replacement therapy:
	  ○ Hemodialysis
	  ○ Peritoneal dialysis
	  ○ Assessment of dialysis adequacy
	  ○ Renal transplantation
	  ○ Markers of transplant rejection
	– Prostate cancer

Module	Details
Gas transport and H^+ metabolism	– Physiology of normal respiration: blood buffers: transport of O2 and CO2 – Respiratory and renal mechanisms in acid-base homeostasis – Respiratory diseases – Principle types of acid base disturbance and their causes – The concept of actual bicarbonate, standard bicarbonate, and base excess – Oxygen saturation – Determinants and assessment of tissue oxygenation
Water and electrolytes	– Distribution of water and electrolytes turnover of body fluids – Regulation of extracellular fluid osmolality and volume – Antidiuretic hormone – Renin-angiotensin-aldosterone system – Water depletion and excess – Sodium depletion and excess: hypo- and Hypernatremia – Hypo- and Hyperkalemia – Metabolic effects of trauma – Principles of intravenous fluid therapy – Syndrome of inappropriate antidiuretics

Module	Details

Proteins	– Properties and functions of the principal proteins of plasma, including:
	  ○ Albumin
	  ○ Protease inhibitors
	  ○ Transport proteins
	  ○ Ceruloplasmin
	  ○ Clotting factors
	  ○ Complement
	  ○ Immunoglobulins
	– Hypoalbuminemia and its investigation
	– Paraproteinemia's and their investigation:
	– Bence-Jones proteins
	– Cryoglobulinemia
	– Proteins of inflammation
	– Understanding of plasmapheresis
	– Immunoglobulin deficiencies including subclass
	– Alpha-1-antitrypsin deficiency
	– The biochemistry and chemical pathology of collagen
	– Cytokines

Module	Details
Lipids and cardiovascular system	– Apoliproteins and their role in lipid metabolism The inherited and acquired hyper- and hypo-lipoproteinemias and their metabolic basis Laboratory investigation and principles of management of hyperlipidemic states – Atheroma, coronary heart disease, and associated risk factors – Biochemical markers of myocardial infarction Hypertension (investigation and management)
Diabetes mellitus and hypoglycemia:	– Glucose metabolism Classification of diabetes Etiology of diabetes: – Type 1 diabetes – Type 2 diabetes Complications of diabetes: – Diabetic ketoacidosis – Hyperosmolar and hypoglycemic coma Nephropathy and “microalbuminuria” Neuropathy and retinopathy – Lipid abnormalities – Principles of treatment and diabetes and monitoring of diabetic control: ○ Use of insulin and other pharmacological agents ○ Dietary modification ○ Home monitoring with reagent pad tests and meters – Glycated hemoglobin and glycated proteins – Causes and laboratory investigation of hypoglycemia in the adult – Use of insulin, C peptide, and glucagon assays
Endocrinology	– General ○ Feedback mechanisms and endocrine control ○ Mechanisms of action of steroid, protein, and thyroid hormones–hormone receptors ○ Principles and limitations of immunoassays and biological assay of hormones

Module	Details

Endocrinology	– Hypothalamus
	  ○ The role of hypothalamic releasing and inhibiting factors
	– Pituitary
	  ○ Physiology and pathology of the hormones of the anterior and posterior lobes
	  ○ Growth hormone and somatotropin
	  ○ Acromegaly and dwarfism
	  ○ Prolactinoma
	  ○ Diabetes insipidus (cranial and nephrogenic)
	  ○ Dynamic function testing of pituitary reserve
	  ○ Isolated pituitary hormone deficiencies and panhypopituitarism
	– Adrenal cortex:
	  ○ Adrenal steroid production
	  ○ Cushing's syndrome and its investigation:
	  - Plasma cortisol
	  - Urinary free Cortisol
	  - Adrenal suppression tests
	  - Petrosal sinus sampling
	– ACTH assay:
	– Addison's disease and its investigation
	  ○ Assessment of adrenal reserve
	  ○ Conn's syndrome and its investigation
	  ○ Congenital adrenal hyperplasia and its investigation
	  ○ Low renin hypertension
	– Adrenal medulla
	  ○ Catecholamine synthesis
	  ○ Pheochromocytoma
	  ○ Neuroblastoma
	  ○ Interpretation of plasma catecholamines and their urinary metabolites
	– Thyroid:

Module	Details
	○ Thyroid physiology ○ Congenital hypothyroidism and screening programs ○ Hypothyroidism and its etiology - Thyroid autoimmunity - Iodine deficiency - Thyrotoxicosis and its etiology - Radioactive iodine *in vivo* studies - Laboratory investigation of thyroid disease and monitoring of thyroid replacement - Problems of interpretation (including binding protein abnormalities, drug effects, and Euthyroid sick syndrome) - Medullary carcinoma of the thyroid: calcitonin – Gonads: ○ Pituitary-gonadal axis ○ Sexual differentiation ○ Menstrual cycle ○ Metabolism of testosterone ○ Ovarian failure and the menopause ○ Polycystic ovarian syndrome ○ Testicular failure ○ Investigation and management of female infertility ○ Investigation of male infertility – Endocrine effects of cancer–ectopic hormones, multiple endocrine neoplasia – Atrial natriuretic peptide

Module	Details
Pregnancy, contraception, and hormone replacement therapy	– Oral contraceptive and their metabolic effects – Pregnancy: physiology, complications, and detection – Tests of feto-placental function: ○ Assessment of fetal maturity ○ Screening for Down's syndrome and fetal malformations ○ Hydatidiform mole and choriocarcinoma ○ Ectopic pregnancy – Hormone-replacement therapy
Calcium and Bone Disease, Magnesium	– Calcium, phosphate, and magnesium homeostasis Osteoporosis – Osteomalacia – Renal osteodystrophy – Paget's disease – Hyper- and hypoparathyroidism Causes and investigation of hyper- and hypocalcemia – Hypo- and hyperphosphatemia Hypo- and hyperphosphatasemia – Biochemical markers of bone disease Disorders of magnesium balance
Hemoglobin and porphyrins	– Anemia and its investigation: ○ Ferritin ○ Iron ○ Transferrin – Abnormal hemoglobin ○ Altered affinity hemoglobin ○ Methemoglobin ○ Sulfhemoglobin – Metabolic basis of thalassemia and sickle cell disease – Red cell enzyme defects – Porphyrins: ○ Measurement and detection of porphyrins and their precursors (ALA & PBG)

Module	Details
Enzymology	– Stability of enzymes – Isoenzymes—structural basis, separation, and quantitation – Enzyme induction Enzyme variation – Clinical use of enzyme assays with reference to: ○ Amylase and lipase ○ Alkaline phosphatase ○ Aminotransferases ○ Angiotensin converting enzyme ○ Creatine kinase and its isoenzymes ○ Lactate dehydrogenase ○ Gamma-glutamyl transferase ○ Cholinesterase and variants – Enzyme replacement therapy
Genetics and molecular biology	– Protein synthesis ○ Structure of nucleic acids ○ Meiosis and mitosis ○ Transcription and translation ○ Understanding of terminology (e.g., locus, allele, linkage, mutation) ○ Defects in protein biosynthesis arising from genetic mutations – Codes of inheritance: ○ Simple Mendelian and complex diseases ○ Mitochondrial inheritance: implications of modes of inheritance for genetic counseling, antenatal diagnosis, and screening
Neuromuscular system	– Changes in the formation and composition of the cerebrospinal fluid in health and disease Multiple sclerosis – Muscular dystrophy's – Parkinson's disease – Biochemistry of psychiatric disease – Biochemistry of muscular disease

Module	Details
Cancer	– Nature of malignancy and tumor growth Common malignancies of adulthood Malignancies of childhood in which biochemical – tests have a role (neuroblastoma, hepatoblastoma, and teratoma) – Biochemical effects of cancer and its treatment Tumor markers
Metabolic response to insult	– Trauma – Burns – Water and electrolyte balance
Pediatric Clinical Biochemistry	(Residents are not expected to have in-depth knowledge of all aspects of Pediatric Clinical Biochemistry, but should be aware of the common methods of Pediatric Clinical Biochemistry testing, including the biochemical problems of newborns). – Common biochemical problems in the neonate: ○ Surfactant; respiratory distress fluid balance disturbances ○ Physiological and pathological jaundice ○ Neonatal liver disease: metabolic causes ○ Neonatal hypoglycemia ○ Disorders of calcium and phosphate homeostasis; metabolic bone disease of prematurity ○ Hypomagnesaemia
Nutritional disorders	(Residents are not expected to have an in-depth knowledge of all nutritional disorders, but should be aware of common nutritional disorders; how they present and are investigated; the principles of treatment; and the scope of preventive measures). – Protein-energy malnutrition – Protein markers of nutritional status – The effects and investigation of vitamin deficiency or excess

Module	Details
	– Trace element deficiency–zinc, copper, iron, selenium – Nutritional support–parenteral and enteral nutrition – Obesity
Inborn errors of metabolism	(Residents are not expected to have in-depth knowledge of all inherited metabolic defects, but should be aware of the major categories of defects; how they present and are investigated; mechanisms of inheritance; the principles of treatment; and the scope of prenatal diagnosis). Quantitative and qualitative enzyme Abnormalities occurring in genetic disorders. The biochemical consequences of a primary enzyme block in a metabolic pathway and the way in which clinical and pathological signs may be produced. Methods of detecting metabolic disorders with particular consideration to: ○ Screening selected clinical groups ○ Evaluation of detection programs ○ Prenatal diagnosis – Methods of treatment, in particular: ○ Dietary manipulation – Biochemical monitoring of treatment – Amino acid disorders, especially those involving: ○ Phenylalanine ○ Tyrosine ○ Branch chain amino acids and maple syrup urine disease ○ Methionine and homocysteine ○ Transport disorders, cystinosis, cystinuria, and Hartnup disease – Carbohydrate disorders, including: ○ Glycogen storage diseases

Module	Details
	○ Galactosemia ○ Hereditary fructose intolerance and essential fructosuria – Urea cycle defects – Organic acid disorders – Lysosomal storage disorders – Mitochondrial disorders – Peroxisomal disorders – Purine and pyrimidine disorders (including primary and secondary hyperuricemias) – Cystic fibrosis
Toxicology, drugs, and drug monitoring	(Residents are not expected to have an in-depth knowledge as a toxicologist, but should be able to understand pharmacological and toxicological processes that may commonly occur in health and disease with the relevant underlying analytical investigations). – Monitoring of drug therapy ○ Digoxin and other cardioactive drugs ○ L ○ Anticonvulsants ○ Theophylline and caffeine ○ Methotrexate ○ Cyclosporine and other immunosuppressive drugs ○ Antibiotics – Pharmacokinetics and dosage prediction – Overdosage with: ○ Salicylates ○ Barbiturates ○ Paracetamol ○ Tri-cyclic antidepressants ○ Benzodiazepines – Drug addiction:

Module	Details
	○ Morphine derivatives ○ Amphetamines ○ Metabolic effects of ethanol and methanol – Poisoning with: ○ Lead ○ Mercury ○ Aluminum ○ Carbon monoxide ○ Paraquat ○ Iron ○ Ethylene glycol ○ Organophosphate compounds

R3: Quality and laboratory management

At the end of the formal training, the resident should have achieved a basic knowledge of important aspects of laboratory management, including laboratory service organization; role of staff in pre-, intra-, and post-analytical processes; budget control; staff management; and administration. This will be achieved by the following competencies:

- Develop familiarity with the laboratory service request cycle, workflow and performance.
- Develop awareness of the analytical process and reporting is organized and monitored.
- Recognize the role of automation and IT in laboratory service.
- Implement the scope and concepts of quality assurance and good laboratory practice.
- Comply with the laboratory's safety, policies, and procedures.
- Develop experience in how make new test validation i.e comparison, precision, linearity, sensitivity and specificity.
- Learn the criteria of test validation (accept or reject).

Communicator

Determines the acceptability of patient's results using all the relevant QC information that aids in releasing results. This also includes discussion of the QC report with the responsible technical senior or supervisor for proper data acceptability and communication with other related staff, including QC officers, laboratory information system and tests related vendors.

Collaborator

Collaborates with other laboratory technologists by interpreting daily and monthly QC reports as well as the validity of patient reports. He/she should be able to display good team spirit and interpersonal skills.

Contributes effectively to QC and LIS committee meetings.

Leader

- Develops knowledge of the organizational structure of the laboratory, effective skills in dealing with laboratory employees, familiarity with the current system of data coding, storage, and specimen requirements as well as knowledge of quality assurance & clinical audit.
- Utilizes time and resources effectively to balance patient care, budget restrictions, professional expectations, and alternatives.
- Works effectively and efficiently in a medical laboratory organization.
- Becomes familiar with quality control procedures in Clinical Biochemistry.
- Participates in activities that contribute to the effectiveness of healthcare organizations and systems.
- Leads practice and career effectively.
- Serves in administration and leadership roles, as appropriate.

Health Advocate

- Acquires appropriate QA/QC knowledge and become aware of one's own diagnostic limitations/thresholds to ensure patient safety and

accuracy of patient results.

- Participates in promoting the health of patients as individuals as well as communities. The clinical biochemist should be able to take the opportunity for health promotion and disease prevention and try to play an active role in these.
- Volunteers in non-profit organizations such as Saudi Society for Clinical Chemistry to promote and educate the community about different aspects related to his/her specialty.

Scholar

- Demonstrates a consciousness commitment to continuous learning as well as the creation, dissemination, application, and translation of medical laboratory
- Maintains professional activities through ongoing learning.
- Integrates new learning into practice after analyzing the relevant evidence.
- Is familiar with the arts and principles of critical appraisal and is able integrate conclusions into practice.
- Conducts Medline search skillfully using relevant medical search engines.
- Reviews the literature as necessary in reaching the proper conclusions.
- Develops and implements a personal continuing educational strategy
- Applies the principles of critical appraisal to sources of clinical laboratory information.
- Contributes to the development of new knowledge through research.
- Participates in ground rounds, conferences, and teaching sessions.
- Maintains and enhances professional activities through ongoing learning.
- Critically evaluates information and its sources, and applies this appropriately to practice decisions.

- Facilitates the learning of technical staff, students, interns, residents, other health professionals, the public, and others, as appropriate.
- Contributes to the creation, dissemination, application, and translation of new clinical laboratory knowledge and practices.

Professional

- Abides by the code of Ethics for Healthcare Practitioners published by the SCFHS.
- Is committed to the health and well-being of individuals and society through ethical practice sourced by both the guidance of Islam and internationally agreed upon ethics.
- Develops personal standards of behavior that is inspired by manners in Islam and develops the best of manners within him/herself such as:
  - Truthfulness
  - Honesty and integrity
  - Humility and respect for others
  - Patience
  - Passion and love
  - Moderation and fairness
- Delivers the highest quality of care with integrity, honesty, and compassion.
- Practices medical laboratory in an ethical manner, with sensitivity to diversity in patients and co-workers.
- Exhibits appropriate professional behavior and perform duties in a dependable, consistent, and responsible manner.
- Demonstrates commitment to excellence and ongoing professional development.
- Demonstrates a commitment to their colleagues, profession, and society through ethical practice.
- Demonstrates a commitment to their profession and society through

participation in profession-led regulation.

***Professionalism is to be practiced towards both patience and colleagues alike.**

http://www.scfhs.org.sa/Media/OtherPublications/Documents/%d8%a3%d8%ae%d9%84%d8%a7%d9%82%d9%8a%d8%a7%d8%aa%20%d8%a7%d9%84%d9%85%d9%85%d8%a7%d8%b1%d8%b3%20%d8%a7%d9%84%d8%b5%d8%ad%d9%8a.pdf

Module	Details

Quality Assurance	– Quality control methods
	– Internal quality control programs
	– Quality control rules
	– Use of external quality assessment programs
	– Interpretation of QC/QA data and subsequent course of action
	  – New test validation.
	  – Accept or reject validation.
	– Assisting Laboratory Quality Control Officer (minimum one month)
	– Attendance at laboratory quality control meetings (minimum 10)
	– Laboratory accreditation systems

Health and Safety	– Individual and collective responsibility – Handling of potentially infectious samples (HIV and hepatitis B) – Handling of noxious chemicals – Radiation protection measures – Mechanical and electrical safety – Fire precautions – Dealing with an accident – Attendance to Laboratory Safety Committee meetings (minimum 5)

Module	Details
Selection of Analytical Equipment	– Specifications for analytical system – Evaluation of analytical system – Basic appreciation of financial issue relating to analyzer installation (e.g., capital purchase, reagent rental, competitive tendering)
Patient to Report and Laboratory Computers	– Different stages in the process of producing results and potential problems with turnaround times – Instrument interfaces – Links to other computers e.g., patient administration, pharmacy, clinical administration – Reporting/authorization procedures – Patient identification and methods to ensure accuracy – Management statistics from laboratory computers – Use of e-mail and the intra-/internet – Data protection
Clinical Auditing	Conduct proper examination and verification review of a process/method and write an official report presenting the audit process. This may be on an administrative process, e.g., laboratory budget report, Quality or safety, e.g., occurrence variance incident (OVA) report, patient safety report, or clinical methodology

R4: Research and dissertation

During this section of the training, the resident is expected to develop the needed research skills to enable him/her to undertake analytical and clinical based-research and/or development projects.

Communicator

1) Be able to understand the most common statistical methods and to be able to provide advice whenever requested.
2) Be able to know about the research ethics and the required channels to do a research.
3) To set up a research the clinical biochemist needs to know how and why to communicate different departments (e.g. laboratory, research office, library, research center, etc).

Collaborator

1) Being able to work with the team of his/her research and be effective team member.
2) Collaborate with all members of the pathology team which include technical, students, administrative, training physicians and senior colleague in order to do a research.
3) Participate with other health care members in professional attitude to obtain and provide information needed for best research.
4) Be able to explain the topic of the research to the involved colleagues.
5) Be involved in a regular meeting with other members.
6) Respect the research ethics and confidentiality

Leader

1) Be able to make decisions about research resources, materials and budget.
2) Collaborate effectively with other organization if research required
3) Identify the persons who should be involved the research proposal

Health Advocate

1) Use his knowledge, skills and expertise to advance health and wellbeing within the community
2) Identify areas for improvement, promotion, disease prevention and advocacy
3) Respond to health care needs within the community
4) Research to meet the community needs
5) Increase the awareness of the community to the need for research, research program and publication.

Scholar

1) Recognizes the importance of a scholar
2) Recognizes the importance of research and continuous medical education
3) Demonstrates the knowledge of basic and clinical research, special research techniques
4) Demonstrates the ability to objectively record results, prepare research proposal and to prepare manuscript
5) Recognizes personal gaps in knowledge and how to tackle them
6) Demonstrates the ability ask appropriate questions and access appropriate resources and references
7) Recognize both planned and opportunistic methods of learning
8) Demonstrates effective personal time management with regards maximizing educational opportunities
9) Capable of self-directed study using appropriate texts and information sources
10) Demonstrates the ability to mentor others and share learned information (health care and non- health care personnel), each at their level of understanding
11) Knowledge and use of virtual libraries and online resources

Practice independent lifelong learning to stay up to date in all aspect of research skills and knowledge also attend specific courses in writing proposal, statistics, statistical software, publication, writing thesis and paper. Courses which can be either provided by the site of training hospitals or by independent courses.

Professional

12) Respect the health and well-being of individuals and society through ethical practice and professionalism.
13) Express commitment to patients, profession, and society through ethical practice which include honesty, integrity, commitment, compassion, respect and altruism
14) Practice commitment to best quality of care
15) Identify and appropriately respond to ethical issues
16) Respect patient's rights and confidentiality

Module	Detail
Basic investigation of a method with particular reference to:	– Practicability – Optimization of reaction conditions – Recognition of critical parameters (robustness) – Bias – Impression – Sensitivity – Specificity – Investigation of common interferences – Range – Criteria for acceptability
Data handling	Criteria for acceptability, including data collection and analyzing data using a proper software, e.g., SPSS

Module	Detail
Research and Development in Health Services	– Topic selection: community, non-community related, molecular, prevalence, disease prognosis, etc. – Writing research proposal and submission
Dissertation	– Access and critically review the literature according to the scope of the research project. – Formulate research questions and develop appropriate experimental design. – Correctly analyze the data by applying the appropriate statistical methods. – Develop research presentation skills and be able to produce and publish research results in peer-reviewed journals and periodicals.

SUBSPECIALTY ROTATIONS

The curriculum and associated competencies relate principally to 'core' (non-elective) training in Clinical Biochemistry. Some subspecialties in clinical biochemistry are considered individual main specialties by themselves. Therefore, a resident in Clinical Biochemistry does not need to be involved deeply in such subspecialty (e.g., metabolic laboratory, which includes inborn errors of metabolism).

Currently, we do not aim to define specific competencies for advanced training in specific subspecialty areas such as Toxicology laboratory, Point of Care Testing (POCT), and metabolic laboratory. The resident pursuing such subspecialty rotation should achieve the general core competencies outlined in a given subspecialty.

Toxicology and trace element rotation

Rotation outline

Toxicology and trace elements are some of the common entities that a clinical biochemist might encounter. The main goal of this rotation is for the resident to know the purpose of measuring toxic materials and trace elements in body fluids for different purposes. In addition to this, the resident must have knowledge on how these substances can be measured and the nature, principle, and operation of instruments utilized in such analysis.

General objectives

- Develop diagnostic competence in the measurement of common tests in toxicology, i.e., therapeutic drug monitoring, drug of abuse screening, forensic drug analysis, and trace element measurement.

- Describe and maintain the chain of custody protocols, which should be followed by laboratory personnel in case of drug of abuse and alcohol screening.
- Differentiate between screening and verification methods.
- Recognize self-limitation and seek second opinion or further investigations when needed.
- Generate comprehensive and meaningful reports and being able to convey his/her message clearly to the clinical team.
- Gain familiarity with all technical aspects and procedures for measuring toxic materials, including both screening and verification methodologies as well as quality assurance.

Clinical competencies

Medical expert

- Demonstrates knowledge of science of toxicology and associated technical aspects.
- Has in-depth knowledge of how to interpret toxicology and trace element results and is familiar with common interferences.
- Knows the procedures of confidential reports sent to the different involved sections and is able to generate a final report with meaningful comments.

Technical expert

- Is able to describe doping and methods of sample adulteration.
- Maintains the principle of techniques utilized in toxicology, e.g., GC-MS, LC-MS, ICP-MS, and other immunoassay tests.
- Is able to describe the most common interferences
- Is able to describe the chain of custody protocols and final report generation.
- Maintain the proper way of using IT support for result reporting.

Communicator

- Communicates effectively with other requesting physicians (i.e., ER or psychiatry departments) regarding positive or negative cases.
- Communicates effectively with other administrative offices (military, civilians etc.) regarding positive or negative cases.
- Is able to generate clear toxicology reports with an effective communication procedure using both oral and written reports with high confidentiality.

Collaborator

- Contributes effectively to other interdisciplinary team activities, including with the laboratory technologists, senior, and supervisor.
- Is able to provide sound advice on how to obtain appropriate toxicology specimens.

Leader

- Uses the resources of the laboratory and the institution appropriately.
- Allocates finite healthcare resources wisely.
- Understands the importance of quality control and quality assurance measures for toxicology samples, including pre-analytical, analytical, and post-analytical variables.
- Takes decision concerning acceptable versus unnecessary requests for processing of toxicology specimens.
- Prioritizes cases according to urgency in a timely fashion.

Health advocate

- Uses his/her knowledge, skills, and expertise to advance health and well-being within the community.
- Responds to healthcare needs within the community.
- Increases the awareness of community to the danger of toxicity due to drugs addictions.
- Participates in campaigns fighting drug addiction, which are usually organized by hospitals, societies, or government interior of ministry.

Scholar

- Practices independent lifelong learning to stay up to date, to obtain the knowledge and skills of toxicology and toxicology screening and help others in learning and improving knowledge for patients, community, and healthcare workers.

Professional

- Respects the health and well-being of individuals and society through ethical practice and professionalism.
- Expresses commitment to patients, profession, and society through ethical practice, which includes honesty, integrity, commitment, compassion, respect, and altruism
- Demonstrates commitment to providing the best possible quality of care.
- Responds quickly to urgent requests and night calls.
- Identifies and appropriately responds to ethical issues.
- Respect patient's rights and confidentiality.

Point of care testing rotation

Rotation outline

Instruments beside the patients which called Point of care testing (POCT) are important to the clinical biochemist to encounter with. Now they are commonly used in most of the hospitals. Their presence become very critical for the life of patients.

General objectives

The main goals of this rotation for the resident are:

- To know the purpose and the setup system of POCT
- To be familiar with the most important tests done by POCT i.e. glucometer, blood gas analyzer, cardiac markers, urine dipstick etc.
- To have knowledge about the system of POCT including IT and

troubleshooting

- To have knowledge about daily quality control follow up and instrument maintenance.
- To know how to do POCT validation and comparison with the main laboratory analyzers.
- To know how to communicate with the vendor in case of reagents shortage, instrument maintenance and IT support.
- To know how to interpret critical results and when to communicate with related patient's physician or respiratory therapist.

Medical expert

- Demonstrates knowledge of the principle of point of care testing (POCT) services, including glucose, blood gas analysis, urinalysis, cardiac markers, and others.
- Is aware of the difference between results from laboratory main analyzer and POCT.
- Explains the discrepancy between main laboratory and POCT results.
- Acquires sufficient knowledge in the interpretation of POCT results
- Prepares reports conveying appropriate information to clinicians

Technical expert

- Describes the principles behind the technical operation and analyte measurement by the POCT.
- Describes the importance of IT communication and its basic principle by using the Midware data system for POCT
- To fulfill the competencies required by each personnel operating the POCT analyzers, e.g., nurses or respiratory therapist.
- Describes the most advanced techniques utilized for POCT and troubleshooting.
- Describes the advantages and limitations of POCT.

Communicator

- Communicates effectively with other physicians regarding critical results.
- Participates in the multidisciplinary POCT hospital committee meetings and contributes to the continuous education of physicians and other team members of the committee.
- Describes the required steps of communications and policies to introduce a new POCT service in the hospital.

Collaborator

- Contributes effectively to other interdisciplinary POCT team members and hospital committee, including laboratory personnel, nurses, infection control, respiratory therapists, and other related end-users.

Leader

- Uses the resources of the laboratory and the institution appropriately, including POCT cost effectiveness.
- Allocates finite healthcare resources wisely.
- Understands the importance of quality control and quality assurance measures for POCT, including pre-analytical, analytical, and post-analytical variables.

Health advocate

- Uses his/her knowledge, skills, and expertise to advance health and well-being within the community on how to use POCT (e.g., home glucometer)
- Responds to healthcare needs within the community.
- Increases the awareness of the community to the use of POCT; e.g., the use of glucometer at home.
- Participates in campaigns, which can improve health and community lifestyle by using POCT analysis for public screening (e.g., World diabetes day).

Scholar

- Contributes effectively to other interdisciplinary team activities, including laboratory personnel, nursing educational office for new staff training.
- Practices independent lifelong learning to stay up to date in all aspect of POCT knowledge, and helps others in improving their knowledge about using POCT for patients and healthcare workers.

Professional

- Respects the health and well-being of individuals and society through ethical practice, and professionalism.
- Expresses commitment to patients, profession, and society through ethical practice, which includes honesty, integrity, commitment, compassion, respect, and altruism:
- Demonstrates commitment to providing the best possible quality of care.
- Identifies and appropriately responds to ethical issues.
- Respects patient's rights and confidentiality.
- Knows limitations and seeks help when in need.

Endocrinology and immunoassay rotation

Rotation outline

Endocrinology is one of the most important sections where the clinical biochemist has to do a rotation.

General objectives

The main goals of this rotation for the resident are to:

- Function effectively as clinical biochemist, integrating all of the CanMEDS roles to provide optimal, ethical and patient-centered medical care.

- Establish and maintain clinical knowledge, skills and attitudes appropriate to endocrinology.
- Apply knowledge of the fundamental in clinical laboratory sciences relevant to the main disorders of endocrinology and metabolism i.e.:
- Growth and development.
- Alterations in the endocrine system in pregnant women.
- Disorders of glucose metabolism including hypoglycaemia and hyperglycemia.
- Disorders of lipid metabolism.
- Disorders of obesity.
- Type 1 and Type 2 diabetes mellitus
- Metabolic bone disease and disorders of calcium metabolism including but not limited to disorders of the parathyroid glands and the Vitamin D.
- Disorders of the thyroid gland.
- Disorders of reproduction in males and females
- Disorders of growth in children and adolescents (limited to pediatric
- Endocrinology and Metabolism).
- Disorders of the adrenal cortex and the adrenal medulla.
- Disorders of the pituitary gland (anterior and posterior).
- Hypertension related to endocrine disorders.
- Fluid, electrolyte and acid-base disorders to the endocrine system.
- Autoimmunity as it relates to the endocrine system.
- Nutrition as it applies to endocrine disorders.
- Genetics as it relates to endocrine disorders.
- Endocrine tumors and cancers.
- To have knowledge about daily quality control, follow up and instrument maintenance.
- To know how to do endocrine test validation.
- To know the most common techniques utilized for endocrine tests

measurement and their benefits and limitations.

- To know how to interpret critical results and when to communicate with related patient's physician or respiratory therapist.

Clinical competencies

Medical expert

- Has a comprehensive knowledge about general endocrinology and its related diseases, including thyroid, fertility hormones, and steroids.
- Acquires sufficient knowledge about the interpretation of immunoassay results, e.g., cardiac, tumor, and bone markers.
- Suggests the appropriate types of specimens and their requirements for any queries from physicians.

Technical expert

- Demonstrates comprehensive knowledge about immunoassay limitations.
- Demonstrates comprehensive knowledge about the possibility of technical errors.
- Demonstrates comprehensive knowledge about the principles of various immunoassays.

Communicator

- Communicates effectively with other physicians (e.g., endocrinologists) to convey critical results.
- Participates in the multidisciplinary team meetings and contributes to the continuous education of physicians about advances in immunoassay testing, i.e., new immunoassay tests.

Collaborator

- Contributes effectively to other interdisciplinary team activities.
- Collaborates with phlebotomists and nurses on how to obtain appropriate specimens for endocrine blood samples.

Leader

- Uses the resources of the laboratory and the institution appropriately.

- Allocates finite healthcare resources wisely.
- Understands the importance of quality control and quality assurance measures for immunoassays, including pre-analytical, analytical, and post-analytical variables.

Health advocate

- Uses his/her knowledge, skills, and expertise to advance health and well-being within the community.
- Responds to healthcare needs within the community.
- Researches to meet the community needs.
- Increases the awareness of community by participating in public campaign (e.g., world diabetes day).

Scholar

- Practices independent lifelong learning to stay up to date in all aspect of endocrinology and other knowledge and skills by attending symposiums and conferences.
- Helps others in learning and improves knowledge for patients, community, and healthcare workers.

Professional

- Respects the health and well-being of individuals and society through ethical practice, and professionalism.
- Expresses commitment to patients, profession, and society through ethical practice, which includes honesty, integrity, commitment, compassion, respect, and altruism.
- Practices commitment to providing the best possible quality of care.
- Responds quickly to urgent requests and night calls.
- Knows his/her limitations and seeks help when in need.
- Identifies and appropriately responds to ethical issues.
- Respects patient's rights and confidentiality.

Biochemical metabolic laboratory

Rotation outline

Residents are not expected to have in-depth knowledge of all aspects of biochemical metabolic laboratory, which mainly concerns inborn errors of metabolism in pediatric. The resident should be aware of the common metabolic disorders in pediatric.

Clinical competencies

Medical expert

- Develops and demonstrates the ability to know the background of the most common metabolic disorders in pediatric.
- Attains sufficient knowledge about the newborn screening program (NBS) and its structure, objectives, and outcomes.
- Describes the common and non-common laboratory tests and their requirements for the most common metabolic disorders.
- Is aware of the consequences of the delay in patient treatment.
- Demonstrates adequate knowledge on using high-quality newborn filter paper with proper blood sampling.

Technical expert

- Demonstrates familiarity with the main instruments, which should be available in metabolic laboratory.
- Understands the principle of the main techniques utilized in metabolic laboratories, e.g., GCMS, LC-MS, ICP-MS, and other immunoassay tests.
- Demonstrates the most common technical practices in metabolic laboratory.
- Is familiar with the available IT facilities for result reporting and technical alerts.

Communicator

- Communicates effectively with laboratory technologists, supervisor, metabolic coordinator, metabolic consultants, pediatric consultants, and other members of the NBS program.
- Clearly requests further inquiries from the proper staff.
- Participates in regular meetings for members of the NBS.
- Makes laboratory reports with possible diagnosis and is able to write clear comments or further recommendations if needed.
- Communicates with referral laboratories for test requirements and result follow up.

Collaborator

- Contributes effectively to interdisciplinary team activities by participating in the regular NBS committee meetings.
- Works with other team members, including nursing, consultants, and laboratory coordinators to make the program of NBS more efficient.
- Seeks appropriate consultation from other health professionals such as the pediatric department.
- Efficiently follows up referral/out samples. Makes use of the limited diagnostic material available effectively and efficiently to reach definitive diagnosis and convey the result in a clear and timely manner.

Leader

- Works well with fellow colleague residents and technologists as well as clinical consultants in follow up results to reach a diagnosis.
- Is able to troubleshoot any problems related to quality assurance and quality control in laboratory operation, especially those related to sample quality.

Health advocate

- Promotes the advanced technical instruments that play an important role in diagnosis and strives to introduce the relevant new technologies locally
- Helps establish outreach programs and provides assistance to referral centers to facilitate accurate diagnosis and better management.
- Educates patients' families about the importance of NBS.

Scholar

- Is committed to personal continuing educational strategies to keep up to date with new classifications, diagnostic criteria, and developments.
- Critically evaluates information and its sources and applies this appropriately to reach decisions.
- Facilitates the learning of patients, families, students, residents, other health professionals, the public, and others, as appropriate.
- Contributes to the creation, dissemination, application, and translation of new medical knowledge and technical practices.

Professional

- Delivers care of the highest quality with integrity, honesty, and compassion.
- Demonstrates the maturity and responsibility expected of all professionals.
- Exhibits appropriate personal and interpersonal professional behavior.
- Responds quickly to urgent requests and night calls.
- Knows his/her limitations and seeks help when in need.
- Practices medicine that is ethically consistent with Islam and the obligations of a physician.

Quality and safety program rotation

Rotation outline

This rotation focuses on the resident getting essential background of how to review and read daily, weekly, and monthly quality control reports and how to take decision for accepting or rejecting patient results. In addition, the resident should have the ability to troubleshoot QC outliers and laboratory documentation to make sure he/she has adequate knowledge and problem solving skills. This rotation also focuses on the resident to adhere to laboratory safety guidelines and standard precautions in dealing with pathogens, chemical spills, and emergency codes in clinical laboratory environment.

Technical expert

- Understands the background of quality control rules and application.
- Understands the criteria for results acceptability.
- Troubleshoots QC results outside the acceptable limits.
- Checks daily, weekly, and monthly QC reports.
- Checks internal and external QC reports.
- Reads the required policies for laboratory safety issues.
- Recognizes the materials that should be available for the purpose of laboratory safety and hazard precautions.

Communicator

- Establishes the ability to communicate with technical, senior, and laboratory supervisors to inspect the daily QC and troubleshooting if required.
- Demonstrates abilities to use the various types of communication when required (verbal, oral, and written)
- Exhibits the need of effective communication with laboratory quality administration officers.

- Has the ability to understand internal and external QC report as a tool of communication.
- Communicates with the laboratory safety officer.

Collaborator

- Possesses effective skills to participate in a multidisciplinary team of quality officers.
- Demonstrates a respectful attitude towards other colleagues and members of a professional team.
- Works with other professionals to prevent conflicts.
- Acquires skills to establish a professional bond with the team staff, collaborative professionals, learners, and the community.
- Able to use various types of communication when required (verbal, written, and oral)
- Is able to communicate effectively, quickly, clearly and accurately with different agencies and professionals.

Leader

- Demonstrates an understanding of and is familiar with both the authorizing body management structure and the laboratory management structure and their relationship.
- Understands the principles of workload requirements and time management.
- Demonstrates knowledge of laboratory safety for all personnel.
- Understands the principles of laboratory information systems.
- Understands the principles of quality assurance, quality control, and quality improvement.
- Has knowledge of the regulations pertaining to the safety, e.g., storage of chemicals

Health advocate

- Understands and demonstrates the role of the clinical biochemist in providing accurate results due to the application of quality regulations.
- Understands and demonstrates the role of all necessary safety precautions in dealing with dangerous materials for laboratory officers and others as a health advocate.

Scholar

- Recognizes the importance of a scholar.
- Recognizes the importance of research and continuous medical education.
- Demonstrates knowledge of basics in quality.
- Demonstrates the ability to objectively read QC reports by attending dedicated courses and reading related books.
- Recognizes the importance of attending symposiums, conferences, and lectures dedicated to quality programs.
- Attends courses related to laboratory safety programs on a regular basis.

Professional

- Recognizes his/her limitations and seeks assistance when required.
- Demonstrates a collegial manner at all times.
- Responds appropriately to criticism or notification.
- Demonstrates punctuality.
- Demonstrates competency, integrity, and honesty.
- Respects confidentiality regarding any information obtained because of his/her occupation.

Molecular biochemistry laboratory

Objectives

Rotation general goals

- To provide an understanding of basic molecular biology techniques in molecular biochemistry
- The resident is expected to have grasped comprehensive knowledge of principles and concepts of the molecular basis of diseases by this stage and the rotation will aim to reinforce the clinical use of this knowledge.
- To understand the molecular biomarkers in diagnosis, prognosis, predictive, therapeutic, and monitoring of diseases.
- To understand the various indications of molecular testing in disease processes.
- To appreciate the role of the biochemist in molecular testing.
- To have a general idea about quality control/assurance and total quality management in molecular testing.

Clinical competencies

Medical and technical expert

- Develops and maintains basic and clinical knowledge of molecular biochemistry and disease processes in cases of metabolic disorders.
- Is familiar with the principles of PCR, NAT, sequencing, electrophoresis, instrumentation, data processing, and software analysis.

Communicator

- Takes the opportunity to educate the members of the multidisciplinary team and colleagues during metabolic disorder conferences and presentations on issues related to genetics, molecular biology, and genomics in metabolic disorders of the newborn.
- Is part of patient management by advising clinicians when needed about the indications, interpretations, and clinical utility of molecular assays and on molecular aspects of hereditary diseases.
- Communicates with requesting physicians to advise them on the appropriate use of molecular diagnostic methods.

Collaborator

- Collaborate with molecular biology section for result interpretation, diagnosis and the appropriateness of the requested tests before test referral (in case test is not available).'
- Facilitates the requests of clinicians in ordering particular tests vital for patient health management and cost.

Leader

- Understands issues of quality control, quality improvement, risk, cost-effectiveness, and laboratory management as they specifically relate to molecular biochemistry.
- Is familiar with quality management and quality essentials in molecular biochemistry.

Health advocate

- Engages health professionals and the medical community in determining appropriate laboratory utilization of molecular testing to advance healthcare
- Recognizes advances in molecular biology that can be applied to molecular diagnostics to increase the efficiency of diagnostic techniques.

Scholar

- Is committed to a personal continuous education strategy
- Is up to date with the rapidly developing field of molecular genetics and genomics and its application to laboratory diagnostics.
- Is able to search the scientific literature to critically assess the development of new tests in molecular biochemistry.

Professional

- Demonstrates a commitment to excellence and ongoing professional development.
- Demonstrates a commitment to patients, profession, and society through ethical practice and through participation in profession-led regulation.

Research rotation

Objectives

Clinical biochemistry residents are required/should be encouraged to complete a one-year rotation with a certified researcher or in a recognized research department or facility during the fourth year of training. The purpose of this rotation is to expand the resident's knowledge and research skills and to increase his/her understanding of basic science, and interpretation of statistical data. During this rotation, the resident should be able to develop an idea and conduct research projects during his/her training year*.

The resident is advised to read and understand the SCFHS publication: "Introduction to Clinical Research for Residents. https://www.scfhs.org.sa/en/Media/OtherPublications/Documents/Introduction%20to%20Clinical%20Research.pdf

Clinical competencies

Medical expert

- Can generate research ideas in relation to the field of clinical biochemistry.
- Can conduct literature searches.
- Can read, interpret, and critique articles.

Technical expert

- Selects the appropriate study design to answer one's question.
- Can read and interpret statistical data.
- Knows how to write a paper.
- Can conduct a computerized literature search using Medline, PubMed, or an equivalent database.
- Can choose and design a research project in an optimized way.
- Can use statistical software and do independent data analysis, e.g., SPSS.

Communicator

- Presents one's project during grand rounds or an academic or research day upon conclusion of the project.
- Can write a scientific abstract for potential submission to a regional, national, or international research meeting.

Collaborator

Can work with other team members from different specialties on a combined project.

Health advocate

- Advocates for research to promote the understanding of various disease processes or means of delivering care.

Leader

- Understands the cost of research and can set a budget plan.

Scholar

- Compares his/her data to those previously collected and determines differences.
- Is able to determine the reason for similarities or differences in one's study.

Professional

- Respects patients' privacy, with respect to medical information, when performing research.
- Understands the function of an IRB (Institutional Review Board) and how it serves to protect patients.
- Has knowledge about research ethics and when to obtain patient consent (http://www.scfhs.org.sa/Media/OtherPublications/Documents/Introduction%20to%20Clinical%20Research%20for%20Residents%20(16.9.14)%20Hani%20Tamim%20(FC1).pdf).
- Is honest in reporting data.

Other subspecialty rotations

These rotations might be incorporated with other department's rotations or be taken as a separate rotation depending on the hospital that the resident is rotating in. The choice shall be made based on the relevance to the specialty, e.g., a rotation in a genetic section may be feasible to support the knowledge gained during the section on hormones. Therefore, other laboratory departments may include, but are not limited to:

- Hematology
- Immunology
- Microbiology

ELECTIVE TRAINING OUTSIDE THE KINGDOM

Elective training outside the kingdom is permissible under the following regulations:

- The resident should be in the third or fourth year of training.
- Training is allowed for a maximum of 3 months.
- Application along with the acceptance letter from the institute should be submitted 6 months before the start of the next academic year.
- A confidential sealed and stamped evaluation by his/her supervisor in the institute abroad should be provided.
- Please note that if the elective rotation is performed in a subspecialty domain then this period will be deducted from his/her training period in that particular domain.
- The reason for training abroad should be one of the following:
  - Research collaboration with another institute (fourth year)
  - Training for a technical procedure that is usually not commonly available inside the kingdom.
  - Attendance at accredited international courses or conferences for presentation or poster presentation.

Rotation structure

Program rotations and diagnostic experience

- The residents will rotate through different hospitals, as arranged by the local supervising committee.
- At each rotation, the resident will gain a unique experience about clinical and technical experience.

Service and duties

- These should comprise a significant part of the resident's development and education.
    - Sufficient time during which supervising consultants can teach and advise residents should be available during the performance of these duties.
    - The resident should be able to conduct the routine procedures carried out during a specific rotation set by the department.
    - Senior residents may supervise junior residents in carrying out their duties under the direct supervision of the consultant.
    - In each rotation, the resident should gain the maximum benefit and meet the rotation goals and objectives.
    - Each resident must choose a minimum of one case and present it as a case presentation
    - Present a minimum of one journal club/article presentation

Please refer to the section of teaching and academic activity for further details and guidelines. Appendix D, E and F show examples of Resident Presentation Evaluation Form by staff supervisor, Activity Evaluation Form, and Lecture Evaluation Form.

TEACHING AND ACADEMIC ACTIVITIES

Teaching and learning will be structured and programmatic, with more responsibility for self-directed learning.

Internal educational material

Mandatory Activities

Each institution is requested to provide or to allow the resident to attend the following educational activities that are arranged by the local committees:

For R1 Residents:

- Basic Clinical Biochemistry.

For All Residents (venue to be announced for each session):

- Academic Half Day (Twice a month)
  - Presently Bi-Monthly and in some regions once weekly, at least 4–6 hours of formal training time should be reserved for resident academic half day. Formal teaching time is planned with an assigned tutor, time slots, and a venue.
  - Resident-selected topics are to be presented within the Core Education Program (CEP) in the resident academic half day according to the following guidelines:
    a) Residents will be given the choice to develop a list of topics alone.
    b) They can choose any topics relevant to their needs.
    c) All of these topics must be planned and cannot be random.

d) All of the topics must be approved by the education committee.

e) Delivery will be local, within the program activities.

f) Institutions can work with residents to determine topics.

Guidelines for Clinical Biochemistry Journal Club

Goals of Journal Club

- Teach critical appraisal
- Keep current with the medical literature
- Provide a foundation for evidence-based practice
- Review landmark or controversial papers

Characteristics of successful Journal Clubs

- Presented by residents and actively supervised by a staff member
- Attendance mandatory for residents
- Meetings lasting for less than 60 minutes
- Supported and endorsed by the Program Director and departmental leaders

Problem-Based Learning

Choose 1–2 relevant journal articles that:

- Are related to the specialty
- 20 minutes for presentation, followed by 10 minutes of critiques for each paper
- Topics for discussion may be:
- Ask, “so what?”
- Will it change my practice?
- Is the question important?

Purpose

- Research question, study objective, and specific hypothesis:
  - Do the authors provide a clear and specific question and hypothesis?
  - Is the research objective clear and unambiguous?

Critically Reviewing Articles

- Methodology:
- Is the study design appropriate for the research question?
- Pros and cons of this design
- Pros and cons of alternative methodologies
- Advantages and disadvantages of the chosen methodology
- Level of evidence
- Confounding, bias, and validity

Study Population

- Characteristics of the study population:
  - Who are the participants?
  - Where and when will the study be conducted?
    a) Is the study population appropriate?
    b) Characteristics of the sample
  - Random versus convenience sampling
  - Is the population similar to that of my patients?
  - Specific inclusion and exclusion criteria
  - Are these appropriate?
  - Is selection bias present?

Measurement Issues and Bias

- How are variables measured?
- Is misinformation bias present?
- Is detection bias present?
- Was masking or blinding conducted?

Statistical Analysis

- How were the data analyzed?
  - Appropriate tests
  - *P* values versus sizes and 95% confidence intervals (more
  - informative)
  - NS versus actual *P* values
  - Multivariable methods
  - Was regression analysis used?

Sample Size and Power

- Were sample size calculation performed a priori?
- Did the investigators specify a clinically important difference they would like to detect?
- Were Type I (α or alpha) and Type II (ß or beta) errors Power = 1-type II errors present?

Results

- What are the results?
- Are they clearly presented and understandable?
- How were the results interpreted?
- Are the interpretations appropriate?
  - Threats of validity
  - Loss to follow-up
  - Missing information
  - Control of confounding parameters
  - Issues of bias

Discussion

- Are the conclusions supported by the data?
- Do the authors relate findings to those of other studies in the medical literature?
- Do the authors "stretch" too far?
- What are the strengths of the study?

- What are the study weaknesses or flaws?
- Do the authors recognize them?
- Come back to the key question: So what?
- Will it change how we practice?
- Will it change how we counsel patients?

Conclusions

- Where to from here?
- Do the findings contribute to our knowledge of the subject?
- How could we do better?
- What additional questions does the study raise?

Other Activities

- The residents should be encouraged to attend the self (MOCK) accreditation inspection (CAP, CLIA, JCIA, and CBAHI)
- Hospital/Departmental grand rounds and other Continuous Medical Education activities

* All educational activities should be documented, and the following information should appear in the QC sheet: date, title, name of residents attended the session, name of clinical biochemist teaching the session.
* The resident is required to attend at least 75% of all educational activities held at the institute where he/she is training.

Optional activities

Each institution must encourage the following educational activities:

- The resident is encouraged to present at least once a year at a local, national, or international clinical biochemistry meeting.
- The resident is encouraged to review the department teaching file.
- The resident should be encouraged to attend any national educational activities (Symposia, Workshops, or Review course)

External Educational Material

Suggested Activities

- Accreditation team member inspector course online (certified CAP inspector).
- American Society for Clinical Pathology (ASCP)
- American Association for Clinical Chemistry (AACC)
- Association for Clinical Biochemistry and Laboratory Medicine (ACB)
- International Federation for Clinical Chemistry (IFCC)

ASSESSMENT

1. General Rules:

The Postgraduate Assessment System for the SBCB forms a continuum of competency-based evaluation processes throughout the program years starting from day one to the final assessment at the end of training.

The SBCB assessment framework complements the Assessment and Promotion Rules and Regulations adopted by the SCFHS, and the principles of Competency Based Training assessment and evaluations of best practices. The assessment methods are composed of formative and summative assessment. These methods are used to facilitate learning through processes of feedback, identification of learning gaps, and repeated attempts to correct failures.

2. The difference between formative and summative assessment:

The goal of formative assessment is to monitor resident learning to provide ongoing feedback that can be used by trainers to improve their teaching and by residents to improve their learning. More specifically, formative assessments help students identify their strengths and weaknesses and target areas that need improvement and help faculty recognize where students are struggling and address problems immediately. On the Other hand, the goal of summative assessment is to evaluate residents' learning at the end of an instructional unit by comparing it against standards or benchmarks. The table below summarizes differences between formative and Summative assessments:

	Formative	Summative
What	Assessment FOR learning	Assessment OF learning
Purpose	Improve learning and teaching	Measure of competencies
When	On-going	End of course
How used by residents	Learn through feedback and practice	Grades

3. Formative Assessment Components:

The formative assessment component of SBCB is aiming to provide continuous multiple and variable insights of residents' performance around the year. The formative assessment is composed of different tools that are intended to measure various aspects of competencies. The following tools are agreed upon by Curriculum Development Team to be implemented in the current version:

Knowledge

The formative assessment tools to assess knowledge are as follow:

1. Academic Activity Evaluation:

Description: This component of formative assessment is aiming to evaluates the residents' capacity to demonstrate understanding the learning contents of the whole academic year.

Score: 100%

Interpretation:

- < 50%: Clear fail
- 50 - 59.9%: Borderline fail
- 60 - 69.9%: Borderline pass
- 70% or more: Clear pass

Methods:

An average score of resident performance during active participation in the academic activities (including Presentations, Journal Clubs, Case Discussions, Teaching.... etc.) using Academic Activity Evaluation Reports (see Appendix C).

2. End of year Progress Test-Local (EYPT-local):

Description: This component of formative assessment evaluates the residents' capacity to recall, understand, analyze, and generate decisions about the learning contents of the whole academic year.

Score: 100%

Interpretation:

- < 50%: Clear fail
- 50 - 59.9%: Borderline fail
- 60 - 69.9%: Borderline pass
- 70% or more: Clear pass

Eligibility:

- Valid registration with the SCFHS
- Completion of at least 9 months of the academic year before setting for the exam

Methods:

R1-R3:

- A written examination shall consist of not less than 100 MCQs with a single best answer (one correct answer out of four options)
- The examination shall contain type K2 questions (interpretation, analysis, reasoning, and decision making) and type K1 questions (recall and comprehension)

- The examination shall include basic concepts and topics relevant to the specialty and its relation to different specialties
- The exam duration is 3.0 hours, and it will be delivered as a computer-based test when available; otherwise, a paper-based version will be a substitute

R4:

- Viva Voce Examination (Defiance of the dissertation)

Skills

The formative assessment tool to assess skills is as follow:

1. Practical Assignment Evaluation:

Description: This component of formative assessment is aiming to evaluates the residents' capacity to demonstrate ability to deliver the learning contents of the whole academic year.

Score: 100%

Interpretation:

- < 50%: Clear fail
- 50 - 59.9%: Borderline fail
- 60 - 69.9%: Borderline pass
- 70% or more: Clear pass

Methods:

An average score of resident performance during active participation in the Practical Assignments (including Data Interpretation, Quality control review, Laboratory procedures, Case studies, Validations…. etc.) using Practical Assignment Evaluation Reports (see Appendix D).

Attitude

The formative assessment tool to assess attitude is as follows:

1. In-Training Evaluation Report (ITER)

Description: This component of formative assessment evaluates the residents' attitudes and behaviors toward achieving excellence in patient care, in a specific timeframe (end of each rotation) (Appendices E-H).

Score: 100%

Interpretation:

- < 50%: Clear fail
- 50 - 59.9%: Borderline fail
- 60 - 69.9%: Borderline pass
- 70% or more: Clear pass

Eligibility:

- Complete a minimum of one month in any clinical rotation
- Maintain a 90% attendance rate Methods:
- Supervisor should complete the ITER at the end of 4 weeks in clinical rotations by correlating between residents' clinical excellence and good professional behaviors.
- ITERs should be conducted with each clinical rotation on a monthly basis for all residents in the training program.
- ITERs are submitted to the local supervisory committee or Academic Affairs for each resident based on the expected accomplishments during clinical rotation.
- It will utilize the form in ONE45.

Special considerations:

- The Training Program Committee can use the ITER individually or collectively to formulate judgment regarding passing or failing the specific rotation.
- The annual ITER (performed by the PD or authorized trainer) should reflect the average score of all ITERs during that year.

- The Training Program Committee can omit, modify, or repeat any ITER in case of apparent misjudgment.

Passing Score for Promotion

- To promote any resident to the next level, she/he must obtain at least a "borderline pass" on each assessment tools.
- The program director may recommend to the local supervisory committee (or academic affairs) the promotion of any resident who did not meet the previous promotion requirement according to the following:
    - If the resident achieves a "borderline fail" result on one of the assessment tools, the remaining evaluation forms must be passed with a "clear pass" on at least one of them.
    - If the resident achieves a "borderline fail" result on a maximum of two of the assessment tools, provided they do not fall under the same theme (Knowledge, Skills or Attitude), the remaining assessment tools must be passed with "clear pass" on at least two of them.
    - The promotion must be approved in this case by the Clinical Biochemistry Scientific Committee.

The formative assessment domains and their tools are summarized in the Table below:

#	Formative assessment Tool	Domain
1.	Average score for Academic Activity Evaluation Reports (Appendix --G)	Knowledge
2.	End of Year Progress local Test (EYPT-local)	Knowledge
3.	Average score for Practical Assignment Evaluation Reports (Appendix H)	Skills
4.	Average score for ITERS (end-of-rotation evaluation reports) (Appendices C-F)	Attitude

4. Summative Components

The summative assessment component provides a collective assessment of residents' competencies on two occasions during the training program.

1. SBCB Part One Exam

The Saudi Board Part I Examination shall cover applied basic sciences related to Clinical Biochemistry. Requirements to take the examination are as follows:

- Completion of at least nine months of training in any of the Saudi board certificate programs.
- Valid registration in the Commission postgraduate programs.
- Any other conditions approved by the Council of Education and Training.
- Completion of the examination registration process within the specified period.

General provisions

- The resident may not be promoted from junior to senior level (as determined by the relevant Scientific Council) unless he/she passes the Part I Examination of Saudi board.
- Exemption from the examination owing to the completion of any other previous postgraduate studies/examinations must be approved by the Central Training Committee.
- The Part I board examination will be held once each year on a date published on the Commission website
- Candidates are allowed a maximum of four attempts to pass the Part I board examination, before being dismissed from the program.

Examination format:

The exam shall consist of one paper with 120-150 MCQs (single best answer out of four options).

Passing score:

- The passing score is 65%.
- If the percentage of candidates passing the exam before final approval is less than 70%, the passing score can be lowered by one mark at a time aiming at achieving 70% passing rate or a score of 60% whichever comes first. Under no circumstances, may the score be reduced below 60%.

Note:

- Examination details and blueprints are published on the commission website: www.scfhs.org.sa
- Blueprint distributions of the examination may differ up to (±3%) in each section.

2. Final Clinical Biochemistry Board Examination:

In addition to approval of the completion of clinical requirements by the local supervising committee, a Final In-training Evaluation Report (FITER) is also prepared by program directors for each resident at the end of his or her final year in residency (R4). This form includes End of rotation evaluation, Feedback from staff consultants and Completion of research project (see Appendix I).

After completing all the Clinical Biochemistry training requirements and receiving the completion of training certificate, residents can complete the final Saudi Board Examination, which comprises an MCQ written examination. This MCQ examination assesses residents' theoretical knowledge base (including recent advances) and problem-solving capabilities about Clinical Biochemistry. It is held at least once a year. The number of exam items, exam format, eligibility, and passing score will be in accordance with the Commission's training and examination rules and regulations. Examination details and blueprints are published on the commission website: www.scfhs.org.sa

5. Certification:

Certificates of training completion will only be issued upon residents' successful completion of all program requirements. Candidates passing all components of the final specialty examination are awarded the "Saudi Board in Clinical Biochemistry" certificate.

SUGGESTED REFERENCES AND READING RESOURCES

Textbooks

Note: The latest edition of each book is recommended

TITLE	PUBLISHER	AUTHOR CLINICAL BIOCHEMISTRY
Clinical Biochemistry: Metabolic and Clinical Aspects	Elsevier Science Health Science Div.	Marshall, W.J. & Bangert, S.K.
Clinical Chemistry	Elsevier Science Health Science Div.	Marshall, W.J.
Tietz Textbook of Clinical Chemistry	WB Saunders	Burtis, C.A. & Ashwood, E.R.
Tietz Fundamentals of Clinical Chemistry	WB Saunders	Burtis C.A., E.R. Ashwood, D.E. Bruns and N.W. Tietz
ACB Venture Publications	ACB Venture Publications	Various
A Guide to Diagnostic Clinical Biochemistry	Blackwell Scientific	Walmsley R. N. and White G. H.
Clinical Chemistry: Theory, Analysis, Correlation	Mosby	Kaplan L.A. , Pesce A.J. , and Kazmierczak S.C.
Clinical Chemistry in Diagnosis and Treatment	Hodder Arnold	Day A., Mayne P. and Mayne P.D.
Clinical Biochemistry: An Illustrated Colour Text	Churchill Livingston	Stewart M.J., Shepherd J., Gaw A., Murphy M.J., Cowan R.A. and O'Reilly D. J.

MONITORING AND MENTORING

Monitoring of Training and Mentoring

Each resident will have a logbook and a checklist to be reviewed by the supervisor and the program directors by the end of each rotation.

It is the responsibility of each supervisor to ensure the completeness of the training requirement each year for his allocated resident and forward a letter to the program director confirming completion. Otherwise, rotations for the next year will have to be modified according to their needs.

Each local program director has to review the logbook and the checklist of his allocated residents to ensure completeness of training for the final exam and to notify the program director at least 6 months before the board examination date.

It is advisable for the resident to have a mentor all through his four-year training. The mentor will follow up the completion of the required training during the five years program and before entering for the final exam. Alterations can be made if/as needed and according to availability.

Mentors, the local clinical scientist or senior resident at the fourth year takes up a leader and a mentor role for the junior residents. He /she should not mentor more than 4–6 residents.

Mentor Responsibilities

- Coordinates with the director to schedule rotations, involving your areas of expertise and responsibility
- Works with the resident to create rotation specific objectives.
- Interacts with laboratory personnel to facilitate logistics of laboratory rotation.
- Serves as a liaison with external partners to facilitate clinical or external aspects of the rotation, as required.
- Meets with the resident on a regular basis (at least once every 4 weeks). Each meeting might take 30 minutes to one hour to review progress, needs, and opportunities of rotation.
- Is available to the resident for inquires and provides guidance to as to where and how the resident can find answers to these inquiries.
- Ensures adequate exposure of the resident to required syllabus topics related to the rotation.

SCFHS guidelines for mentoring:

https://www.scfhs.org.sa/MESPS/PME/SampleCurricula/Documents/Guidelines%20for%20Mentoring.pdf

VACATION AND LEAVES

Vacations/Leave of absence/Educational leave

Annual Leaves

Four weeks of annual leave is permitted and can be taken during the Summer Season provided it will not affect the training flow. The resident should apply for it at least four weeks prior to the date of the annual leave. The annual leave should be taken no later than the end of each academic year or as decided by the respective department or the training supervisor in coordination with the RTC. Emergency and sick leave require the submission of a special form through the supervisor to the RTC.

National Holidays

National Holidays include Eid Al Fitr, Eid AL Hajj, and the National day(s), defined annually according to the Hijra Calendar.

Sick leaves, maternity leaves, and exceptional "emergency" leaves for a period not exceeding ninety days shall be compensated for with an equivalent period of days before the resident is awarded the certificate of training completion

Leaves that are not utilized in due time within the year shall not be shifted to the coming year.

Educational leave

Residents may apply individually for one week of study leave per year subject to the approval of the RTC and the head of the department. The training program director may, in coordination with the chairman of the Regional Training Committee, grant the resident a special leave for scientific purpose not exceeding seven days per training year to attend scientific conferences or seminars in the same or similar specialties provided that he/she presents proof for attending such activities.

APPENDICES

Appendix A

About CanMEDS

As described on the website of the Royal Collage of Canada:

http://www.royalcollege.ca/portal/page/portal/rc/resources/aboutcanmeds

The CanMEDS is an educational framework identifying and describing seven roles that lead to optimal health and healthcare outcomes: medical expert (central role), communicator, collaborator, Leader, health advocate, scholar, and professional.

The overarching goal of CanMEDS is to improve patient care. The model has been adapted around the world in the health profession and other professions.

Appendix B

Weeks	1	6	12	18	24	30	36	42	48
Year 1 (R 1)	General Clinical Biochemistry Principles of the analytical techniques and use of instruments; safety in laboratory; collection, handling, storage, reception, and record keeping of specimens.								
Year 2 (R 2)	Systematic Clinical Biochemistry Biological Variability, Gastrointestinal, Liver, Urogenital, Gas transport and H metabolism, Water & Electrolytes, Lipids & Cardiovascular, Diabetes Mellitus and Hypoglycemia, Endocrinology, Pregnancy, Contraception and HRT, Calcium & Bone disease, Magnesium, Hemoglobin, Enzymology, Neuromuscular, Metabolic response to insult, Pediatrics, Nutritional Disorders, Skills of interpretation of biochemical tests and case studies.								

Weeks	1	6	12	18	24	30	36	42	48
Year 3 (R 3)	Advanced Clinical Biochemistry Genetics & Molecular Biology Techniques, Proteins, Inborn Errors of Metabolism, Toxicology Laboratory Management, Including validation of new assays and instruments, accreditation in the clinical laboratories, etc.								
Year 4 (R 4)	Research Methodology and Statistics				Dissertation and viva Research Skills, Critical analysis, Thesis writing, and Oral discussion (viva)				

Appendix C

Saudi Board of Clinical Biochemistry / Academic Activity Evaluation Report

Resident Name: _____ **Level:** □ R1 □ R2 □ R3 □ R4

Type of Assignment: □ Presentation. □ Journal Club. □ Case Discussion. □ Teaching. □ Other: _____

Training Center: □ PSMMC. □ KFMC. □ KAMC. □ Other: _____

Title of The Activity: _____ **Date of Activity:** _____

Evaluator: _____

A. Assessment of the Resident

Qualities	N/A	Poor 1	Needs Work 2	Good 3	Very Good 4	Excellent 5
Enthusiasm						
Interaction with the Audience						

B. Assessment of the Preparation Process

Qualities	N/A	Poor 1	Needs Work 2	Good 3	Very Good 4	Excellent 5
Information was prepared in an organized manner						
Related information prepared to Academic Activity						
Quality of audiovisual aids						

C. Assessment of the performed Activity

Qualities	N/A	Poor 1	Needs Work 2	Good 3	Very Good 4	Excellent 5
Volume and complexity of the information delivered was appropriate						
Related content to current evidence in the literature						
Content was relevant to your practice						

D. Content in terms of the CanMEDS Roles

Qualities	N/A	Poor 1	Needs Work 2	Good 3	Very Good 4	Excellent 5
1. Medical Expert						
Demonstrated thorough knowledge of the topic						
Presented at appropriate level and with adequate details						
2. Scholar						
Posed an appropriate learning question						
Accessed and interpreted the relevant literature						
3. Professionalism						
Maintained patient's confidentiality if clinical material was used						
Identified and managed relevant conflicts of interest						
4. Health Advocate						
Managed time effectively						
Addressed preventive aspects of care, if relevant						
5. Communicator						
Provided objectives and an outline						
Activity was clear and organized						
Used clear, concise, and legible materials						
Used an effective method/style for the Activity						
Established good rapport with the audience						
6. Collaborator						
Invited comments from learners and led the discussion						
Worked effectively with staff supervisor in preparing the session						

E. Overall Evaluation						
1. Overall Competence = **Total # of scored points** =						
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 5)] x 100 =						
F. Comments						
G. Signatures						
(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators)						
Resident name: _____ Signature: _____ Date: _____						
Evaluator name: _____ Signature: _____ Date: _____						
Program director: _____ Signature: _____ Date: _____						

Appendix D

Saudi Board of Clinical Biochemistry / Practical Assignment Evaluation Report

Resident Name: _____ **Level:** ☐ R1 ☐ R2 ☐ R3 ☐ R4

Type of Assignment: ☐ Data Interpretation. ☐ Quality control review. ☐ Laboratory procedure. ☐ Case study. ☐ Validation. ☐ Other: _____

Training Center: ☐ PSMMC. ☐ KFMC. ☐ KAMC. ☐ Other: _____

Title of The Assignment: _____ **Date of Assignment:** _____

Evaluator: _____

A. Assessment of the Resident						
Qualities	**N/A**	**Poor 1**	**Needs Work 2**	**Good 3**	**Very Good 4**	**Excellent 5**
Enthusiasm						
Interaction with the Team						
B. Assessment of the Preparation Process						
Qualities	**N/A**	**Poor 1**	**Needs Work 2**	**Good 3**	**Very Good 4**	**Excellent 5**
Information was prepared in an organized manner						
Related information prepared to practical Activity						
Quality of used aids						
C. Assessment of the performed Activity						
Qualities	**N/A**	**Poor 1**	**Needs Work 2**	**Good 3**	**Very Good 4**	**Excellent 5**
Volume and complexity of the information delivered was appropriate						
Related content to current evidence in the literature						
Content was relevant to your practice						
D. Content in terms of the CanMEDS Roles						
Qualities	**N/A**	**Poor 1**	**Needs Work 2**	**Good 3**	**Very Good 4**	**Excellent 5**
1. Medical Expert						
Demonstrated thorough knowledge of the topic						
Presented at appropriate level and with adequate details						
2. Scholar						
Posed an appropriate learning statment						
Accessed and interpreted the relevant literature						
3. Professionalism						
Maintained patient's confidentiality if clinical material was used						
Identified and managed relevant conflicts of interest						
4. Health Advocate						
Managed time effectively						
Addressed preventive aspects of care, if relevant						
5. Communicator						
Provided objectives and an outline						
Activity was clear and organized						
Used clear, concise, and legible materials						
Used an effective method/style for the Activity						
Established good rapport with the team						

6. Collaborator						
Invited comments from learners and led the discussion						
Worked effectively with staff supervisor in preparing the session						
E. Overall Evaluation						
1. Overall Competence = **Total # of scored points** =						
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 5)] x 100 =						
F. Comments						
_____ _____ _____						
G. Signatures						
(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators) Resident name: _____ Signature: _____ Date: _____ Evaluator name: _____ Signature: _____ Date: _____ Program director: _____ Signature: _____ Date: _____						

Appendix E

Saudi Board of Clinical Biochemistry / In-Training Evaluation Reports (ITERS) Form

R1 - Module Rotation Evaluation

(Introduction to Clinical Biochemistry & Instrumentation Checklist)

☐ Basic Lab. Techniques & Centrifugation	☐ Osmometry	☐ Solid/Dry Phase Chemistry
☐ Photometric Methods	☐ Enzymology	☐ DNA/RNA Analyses
☐ Automated Instrumentation	☐ Radioisotope Counting	☐ Point of Care Testing/STAT Systems
☐ Electrometric Methods	☐ Immunochemical Techniques	☐ Lab. Data Processing & Computing
☐ Electrophoretic and Chromatographic Techniques		

Resident Name: ..... **Registration #:** .....

Rotation period: from ..... to ..... **Evaluator name:** .....

Training Center: ☐ **PSMMC** ☐ **KFMC** ☐ **KAMC** ☐ **Other**.....

CanMED Competencies (Points/selection)	Meeting Expectations			
	Always Met (3)	Partially Met (2)	Rarely Met (1)	N/A (0)
A. Communicator				
1. Communicates effectively with different levels of clinical and technical colleagues, including technicians, technologists, supervisors, clinical scientists, and consultants, verbally and in written reports.				
2. Develops rapport, trust, and professional relationships with other sections, departments, and allied healthcare workers.				
B. Collaborator				
1. Works effectively with other health professionals to prevent, negotiate, and resolve inter-professional and intra-professional conflicts.				
C. Manager				
1. Manages time to maximize educational resources and opportunities.				
2. Acquires general knowledge on how to allocate finite healthcare resources appropriately.				
3. Serves in administrative and leadership roles, as appropriate.				
D. Health Advocate				
1. Knows and follows all safety precautions in the laboratory facility and strives to implement and follow all rules and regulations at all				
E. Scholar				
1. Maintains on-going learning. Facilitates the learning of students, junior technologists, residents, other health professionals, the public, and others, as appropriate.				
2. Reviews drafts with his/her supervisor and presents at meetings.				
F. Professional				
1. Performs and abides by the codes of ethics.				
2. Demonstrates commitment to excellence and on-going professional development.				
G. Overall Evaluation				
1. Overall Competence = **Total # of scored points** =				
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 3)] x 100 =				

G. Comments

Provide a general impression of the trainee's development during this rotation, including general competence, motivation, and consultant skills. Please emphasize strengths and areas that require improvement:

_____

_____

_____

H. Signatures

(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators)

Resident name: ..... Signature: ..... Date: .....

Evaluator name: ..... Signature: ..... Date: .....

Program director: ..... Signature: ..... Date: .....

Appendix F

Saudi Board of Clinical Biochemistry / In-Training Evaluation Reports (ITERS) Form

R2 - Module Rotation Evaluation

(Systemic Clinical Biochemistry Checklist)

☐ Biological variability	☐ Endocrinology	☐ Ca, Mg & Bone Disease	☐ Gas transport and H+ metabolism
☐ Gastrointestinal tract	☐ DM &hypoglycemia	☐ Hb & porphyrins	☐ Inborn errors of metabolism
☐ Liver	☐ Enzymology	☐ Nutritional disorder	☐ Genetics and molecular biology
☐ Urogenital tract	☐ Met. response to insult	☐ Lipids & CV system	☐ Toxicology, drugs, & drug monitoring
☐ Water & electrolytes	☐ Neuromuscular system	☐ Neuromuscular system	☐ Pediatric Clinical Biochemistry
☐ Proteins	☐ Cancer	☐ Pregnancy, contraception, & hormone replacement therapy	

Resident Name: ..... **Registration #:** .....

Rotation period: from ..... to ..... **Evaluator name:** .....

Training Center: ☐ **PSMMC** ☐ **KFMC** ☐ **KAMC** ☐ **Other**.....

CanMED Competencies (Points/selection)	Meeting Expectations			
	Always Met (3)	Partially Met (2)	Rarely Met (1)	N/A (0)
A. Communicator				
1. Assist in the continuing education of laboratory technologists and other members of the related staff within and outside laboratory by participating in meetings, conferences and case presentations.				
2. Be part of patient management by advising clinician when needed about the indications, interpretations and clinical utility of different assays of diseases.				
3. Communicate with requesting physicians to advise them on the appropriate use of analytical methods.				
B. Collaborator				
1. Demonstrate the ability to advice on the appropriateness of diagnostic tests, teaching and research purposes and to advise on further additional laboratory investigations.				
2. Communicate with requesting physicians to advise them on the appropriate use of additional diagnostic tests.				
3. Facilitate the advice for clinicians in ordering particular tests vital for patient management.				
C. Manager				
1. Utilize time and resources effectively to balance patient care, budget restrictions, professional expectations and personal life.				
C. Health Advocate				
1. As Health Advocates, the trainee should participate in promoting the health of a patient as individuals as well as communities. He/she should be able to take the opportunities for health promotion and disease prevention and try to play an active role in them. The trainee should try to participate in various voluntary work in non-profit organizations such as (e.g. International Diabetes Day) to promote and educate the				

community about the importance of screening and early detection of diabetes. He /she should be familiar with the role of other methods and symptoms to screen for the disease.				
D. Scholar				
1. Contribute to the development of new knowledge through research.				
2. Participate in rounds, conferences and teaching sessions.				
3. Maintain and enhance professional activities through ongoing learning.				
E. Professional				
1. Deliver the highest quality of care with integrity, honesty and compassion.				
2. Practice laboratory medicine in an ethical manner and with a sensitivity to diversity of patient results confidentiality and integrity.				
F. Overall Evaluation				
1. Overall Competence = **Total # of scored points** =				
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 3)] x 100 =				
G. Comments				
Provide a general impression of the trainee's development during this rotation, including general competence, motivation, and consultant skills. Please emphasize strengths and areas that require improvement: _____ _____ _____				
H. Signatures				
(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators) **Resident name**: ..... Signature: ..... Date: ..... **Evaluator name**: ..... Signature: ..... Date: ..... **Program director**: ..... Signature: ..... Date:				

Appendix G

Saudi Board of Clinical Biochemistry / In-Training Evaluation Reports (ITERS) Form

R3 - Module Rotation Evaluation

(Quality & Laboratory Management Checklist)

☐ Quality Assurance	☐ Selection of Analytical Equipment
☐ Health and Safety	☐ Clinical Auditing
☐ Patient to Report and Laboratory Computers	

Resident Name: ..... **Registration #:** .....

Rotation period: from ..... to ..... **Evaluator name:** .....

Training Center: ☐ **PSMMC** ☐ **KFMC** ☐ **KAMC** ☐ **Other**.....

CanMED Competencies (Points/selection)	Meeting Expectations			
	Always Met (3)	Partially Met (2)	Rarely Met (1)	N/A (0)
A. Communicator				
1. Determines the acceptability of patient's results using all the relevant QC information that aids in releasing results. This also includes discussion of the QC report with the responsible technical senior or supervisor for proper data acceptability and communication with other related staff, including QC officers, laboratory information system and tests related vendors.				
B. Collaborator				
1. Collaborates with other laboratory technologists by interpreting daily and monthly QC reports as well as the validity of patient reports. He/she should be able to display good team spirit and interpersonal skills. Contributes effectively to QC and LIS committee meetings.				
C. Manager				
1. Develops knowledge of the organizational structure of the laboratory, effective skills in dealing with laboratory employees, familiarity with the current system of data coding, storage, and specimen requirements as well as knowledge of quality assurance & clinical audit.				
2. Utilizes time and resources effectively to balance patient care, budget restrictions, professional expectations, and alternatives.				
3. Works effectively and efficiently in a medical laboratory organization.				
4. Becomes familiar with quality control procedures in Clinical Biochemistry.				
5. Participates in activities that contribute to the effectiveness of healthcare organizations and systems.				
6. Manages practice and career effectively.				
7. Serves in administration and leadership roles, as appropriate.				
D. Health Advocate				
1. Acquires appropriate QA/QC knowledge and become aware of one's own diagnostic limitations/thresholds to ensure patient safety and accuracy of patient results.				
2. Participates in promoting the health of patients as individuals as well as communities. The clinical biochemist should be able to take the				

opportunity for health promotion and disease prevention and try to play an active role in these.				
3. Volunteers in non-profit organizations such as Saudi Society for Clinical Chemistry to promote and educate the community about different aspects related to his/her specialty.				
E. Scholar				
1. Demonstrates a consciousness commitment to continuous learning as well as the creation, dissemination, application, and translation of medical laboratory.				
2. Maintains professional activities through ongoing learning.				
3. Integrates new learning into practice after analyzing the relevant evidence				
4. Is familiar with the arts and principles of critical appraisal and is able integrate conclusions into practice				
5. Conducts Medline search skillfully using relevant medical search engines				
6. Reviews the literature as necessary in reaching the proper conclusions				
7. Develops and implements a personal continuing educational strategy				
8. Applies the principles of critical appraisal to sources of clinical laboratory information				
9. Contributes to the development of new knowledge through research				
10. Participates in rounds, conferences, and teaching sessions				
11. Maintains and enhances professional activities through ongoing learning				
12. Critically evaluates information and its sources, and applies this appropriately to practice decisions				
13. Facilitates the learning of technical staff, students, interns, residents, other health professionals, the public, and others, as appropriate.				
14. Contributes to the creation, dissemination, application, and translation of new clinical laboratory knowledge and practices.				
F. Professional				
1. Abides by the code of Ethics for Healthcare Practitioners published by the SCFHS.				
2. Is committed to the health and well-being of individuals and society through ethical practice sourced by both the guidance of Islam and internationally agreed upon ethics.				
3. Develops personal standards of behavior that is inspired by manners in Islam and develops the best of manners within him/herself such as: - *Truthfulness* - *Honesty and integrity* - *Humility and respect for others* - *Patience* - *Passion and love* - *Moderation and fairness*				
4. Delivers the highest quality of care with integrity, honesty, & compassion.				
5. Practices medical laboratory in an ethical manner, with sensitivity to diversity in patients and co-workers.				
6. Exhibits appropriate professional behavior and perform duties in a dependable, consistent, and responsible manner.				
7. Demonstrates commitment to excellence and ongoing professional development.				
8. Demonstrates a commitment to their colleagues, profession, and society through ethical practice.				
9. Demonstrates a commitment to their profession and society through participation in profession-led regulation.				
G. Overall Evaluation				
1. Overall Competence = **Total # of scored points** =				
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 3)] x 100 =				

H. Comments

Provide a general impression of the trainee's development during this rotation, including general competence, motivation, and consultant skills. Please emphasize strengths and areas that require improvement:

_____

_____

_____

I. Signatures

(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators)

Resident name: ..... Signature: ..... Date: .....

Evaluator name: ..... Signature: ..... Date: .....

Program director: ..... Signature: ..... Date: .....

Appendix H

Saudi Board of Clinical Biochemistry / In-Training Evaluation Reports (ITERS) Form

R4 - Module Rotation Evaluation

(Research & Dissertation Checklist)

☐ Basic investigation of a method	☐ Research and Development in Health Services
☐ Data handling	☐ Dissertation

Resident Name: ..... **Registration #:** .....

Rotation period: from ..... to ..... **Evaluator name:** .....

Training Center: ☐ **PSMMC** ☐ **KFMC** ☐ **KAMC** ☐ **Other**.....

CanMED Competencies (Points/selection)	Meeting Expectations			
	Always Met (3)	Partially Met (2)	Rarely Met (1)	N/A (0)
A. Communicator				
1. Be able to understand the most common statistical methods and to be able to provide advice whenever requested.				
2. Be able to know about the research ethics and the required channels to do a research.				
3. To set up a research the clinical biochemist needs to know how and why to communicate different departments (e.g. laboratory, research office, library, research center, etc.).				
B. Collaborator				
1. Being able to work with the team of his/her research and be effective team member.				
2. Collaborate with all members of the pathology team, which include technical, students, administrative, training physicians and senior colleague in order to do a research.				
3. Participate with other health care members in professional attitude to obtain and provide information needed for best research				
4. Be able to explain the topic of the research to the involved colleagues				
5. Be involved in a regular meeting with other members.				
6. Respect the research ethics and confidentiality				
C. Manager				
1. Be able to make decisions about research resources, materials and budget.				
2. Collaborate effectively with other organization if research required				
3. Identify the persons who should be involved the research proposal				
D. Health Advocate				
1. Use his knowledge, skills and expertise to advance health and wellbeing within the community				
2. Identify areas for improvement, promotion, disease prevention and advocacy				
3. Respond to health care needs within the community				
4. Research to meet the community needs				
5. Increase the awareness of the community to the need for research, research program and publication				

E. Scholar				
1. Recognizes the importance of a scholar				
2. Recognizes the importance of research and continuous medical education				
3. Demonstrates the knowledge of basic and clinical research, special research techniques				
4. Demonstrates the ability to objectively record results, prepare research proposal and to prepare manuscript				
5. Recognizes personal gaps in knowledge and how to tackle them				
6. Demonstrates the ability ask appropriate questions and access appropriate resources and references				
7. Recognize both planned and opportunistic methods of learning				
8. Demonstrates effective personal time management with regards maximizing educational opportunities				
9. Capable of self-directed study using appropriate texts and information sources				
10. Demonstrates the ability to mentor others and share learned information (health care and non-health care personnel), each at their level of understanding				
11. Knowledge and use of virtual libraries and online resources.				
F. Professional				
1 Respect the health and well-being of individuals and society through ethical practice and professionalism.				
2. Express commitment to patients, profession, and society through ethical practice which include, integrity, commitment, compassion, respect and altruism				
3. Practice commitment to best quality of care				
4. Identify and appropriately respond to ethical issues				
5. Respect patient's rights and confidentiality				
I. Overall Evaluation				
1. Overall Competence = **Total # of scored points** =				
2. Overall Evaluation Score (%) = [(Total # of scored points) / (# of applicable items x 3)] x 100 =				
J. Comments				
Provide a general impression of the trainee's development during this rotation, including general competence, motivation, and consultant skills. Please emphasize strengths and areas that require improvement:				
K. Signatures				
(I certify that I have read all of the parts of this evaluation report and that I have discussed it with the evaluators)				
Resident name: ..... Signature: ..... Date:				
Evaluator name: ..... Signature: ..... Date:				
Program director: ..... Signature: ..... Date:				

Appendix I

SAUDI SPECIALTY BOARD IN CLINICAL BIOCHEMISTRY Final in-Training Evaluation Report (FITER)		
Name of Resident: _____Identification No: _____ Evaluation Period: _____ In the view of the residency Local Committee, this resident has acquired the competencies of the specialty as prescribed in the Objectives of Training and is competent to practice independently. ☐ YES ☐ NO		
The following was used as evidence of competence:		
End of rotation evaluation		
Feedback from staff consultants		
Completion of research project		
COMMENTS		
Date	Name of Program Director	Signature
Date	Name of Local committee Chair	Signature
Date	Name of Resident	Signature

SAUDI SPECIALTY BOARD IN CLINICAL BIOCHEMISTRY Final in-Training Evaluation Report (FITER)		
RESIDENT'S COMMENTS:		
Note: If during the period from the date of signature of this document to the completion of training, the Residency Local Committee decides that the candidate's performance is inadequate this document can be considered null and might be replaced with an updated FITER.		

References

- Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.).