الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

HEMATOPATHOLOGY RESIDENCY PROGRAM

2022


بسم الله الرحمن الرحيم

I. CONTRIBUTORS

This curriculum was prepared by the specialty's Curriculum Development Committee:
• Dr.Tarek Owaidah, MD, FRCPA • Dr.Nasir Bakshi, MD, FCAP • Dr.Randa Al-Nounou, MD, FRCPA • Dr.Afra AlDayel, MD, FRCPC • Dr.Mohammad Al, Mohammadi, MD, FRCPC
Advisory Committee Members (Curriculum Review Committee members):
• Dr.Mazin AlQasimi • Dr.Moawadh AlOtaibi • Dr.Mishal AlOtaibi • Dr.Waleed AlKuraidi
Approved by Head of Curricula Review Committee:
• Dr. Ali AlYahya, MBBS, Msc.MedEd. FRCSC, FACS

II. COPYRIGHT STATEMENT

Correspondence: Saudi Commission for Health Specialties, P.O. Box: 94656, Postal Code: 11614, Contact Center: 920019393

E-mail: Curricula@scfhs.org.sa

Website: www.scfhs.org.sa

III. FOREWORD

The hematopathology residency curriculum development team acknowledges the valuable contributions and feedback from the Scientific Committee's members during the development of this program. We extend special appreciation and gratitude to all the members whose contributions were pivotal in the completion of this booklet, especially those of the Curriculum Group, Curriculum Specialists, and Scientific Council. We would also like to acknowledge that the CanMEDS framework is a product of the Royal College of Physicians and Surgeons of Canada, and many of the competencies described herein were adopted from its resources.

IV. TABLE OF CONTENTS

V. INTRODUCTION

1. Context of Practice:

Hematopathology is the practice of laboratory medicine that concerns the study and diagnosis of blood disorders affecting blood/bone marrow and hematolymphoid tissues. Blood coagulation and transfusion medicine form an integral part of hematopathology.

Hematological disorders, both malignant and benign, are commonly encountered in clinical practice. We know that hemoglobinopathies like thalassemia and sickle cell disorders are the most common inherited single-gene disorders worldwide, with relatively high prevalence in Saudi Arabia. The sickle cell trait affects up to 27% of the Saudi population, and carriers of the beta thalassemia trait comprise 3.5 to 5.9% of the population (1). Bleeding disorders are more common in societies with high rates of consanguineous marriages like Saudi Arabia, with a rate of occurrence up to five times that of Western communities (2). The prevalence of inherited thrombophilia is higher than in most Asian countries and is close to the highest international rate of 5.9%, indicating a greater chance of thrombosis in the Saudi population (3). Leukemias and lymphomas are at the top of the list of the most common cancers found in the Saudi cancer registry (4).

Hematopathologists are also intricately involved with physicians and surgeons in accurately diagnosing non-neoplastic lesions like thrombosis, bleeding, and various types of anemias. Accordingly, the need for competent, dedicated, and safety-conscious hematopathologists in the community cannot be overemphasized.

Worldwide, there are only a few programs for the training of medical graduates with the field of hematopathology as the entry point, like those in

Canada and Australia (5,6). In other systems, the training for hematopathology occurs after general pathology is covered, as in the American system, or it is part of the training in clinical hematology, as in the British system (7,8).

The hematopathology residency program aims to develop academic standards in the field of hematopathology to train graduates, who, after completion of training, will possess sound knowledge of and skills in addressing all the aspects of laboratory hematology required to identify and diagnose various hematological disorders, both benign and malignant. The Saudi Board of Hematopathology (SB-HEMPATH) operates under the auspices of the Saudi Council for Health Specialties (SCFHS). The SB-HEMPATH is the first national and regional program for training medical graduates in hematopathology. The curriculum for the SB-HEMPATH is intended to provide medical graduates with educational experiences and supervisory continuity with detailed training, assessment, and qualification exercises. The SB-HEMPATH will be the basic qualification to prepare candidates for further subspecialty fellowship training in various laboratory hematology specialties, such as transfusion medicine, flow cytometry, lymphoma pathology, molecular hematology, and coagulation.

2. Goals and Responsibilities of Curriculum Implementation:

As “adult learners,” trainees must be proactive and fully engaged and exhibit the following: a careful understanding of learning objectives, self-directed learning practices, problem-solving skills, an eagerness to engage in learning through reflective practices based on feedback and formative assessments, and self-awareness and willingness to ask for support when needed. The Saudi Commission for Health Specialties applies the best models for training governance to achieve the highest quality of training. Additionally, the academic affairs departments in training centers and

regional supervisory training committees play a major role in training supervision and implementation. The specialty's Scientific (Council/Committee) guarantees that the content of this curriculum will be constantly updated to match the highest standards in postgraduate education for each trainee's specialty.

The SB-HEMPATH is the first national program under the SCFHS and one of the few regional programs for training medical graduates in hematopathology. Hematopathology is a constantly evolving specialty, and producing competent candidates is an important step in ensuring the sustainability of the specialty. The context of practice involves other sectors, like molecular laboratory, cytogenetics, transfusion medicine, and immunology. The main goals and objectives of this curriculum are as follows:

- Provide state-of-the-art residency training that develops and produces fully confident hematopathologists who can provide safe, high-caliber diagnostic services in the field of hematopathology.
- Train leaders in hematopathology who can become recognized nationally and internationally for excellence in diagnostic skills, medical education, and clinical research while contributing to the community's health and well-being.
- Guide the program's directors and supervisors inpreposition on the requirements for the training and supervision of residents.
- Provide detailed assessment tools and evaluations during residency.
- Provide guidance for trainees and supervisors regarding all the required skills that must be mastered before completion of the program.

VI. ABBREVIATIONS USED IN THIS DOCUMENT

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
SB-HEMPATH	Saudi Board of Hematopathology
R	Year of Residency
FISH	Fluorescent In-Situ Hybridization
PCR	Polymerase Chain Reaction
ELISA	Enzyme-Linked Immunosorbent Assay
OSCE	Objective Structured Clinical Examination
OSPE	Objective Structured Practical Examination
Mini-CEX	Mini-Clinical Experience Report
DOPS	Direct Observation of Procedural Skills
CBD	Case-Based Discussion
CBE	Competency-Based Education
FITER	Final In-Training Evaluation Report
ITER	In-Training Evaluation Report
COT	Consultation Observation Tool

Abbreviation	Description
RTC	Residency Training Committee
PT	Prothrombin Time
PTT	Partial Thromboplastin Time
PFA	Platelet Function Assay
H&E	Hematoxylin and Eosin Stain
CBC	Complete Blood Count
CSF	Cerebrospinal Fluids
PBL	Practice-Based Learning
TBL	Team-Based Learning
PBM	Peripheral Blood Morphology
QC	Quality Control
MPN	Myeloproliferative Neoplasm
MDS	Myelodysplastic Syndrome
CLL/SLL	Chronic/Small Lymphocytic Leukemia
BM	Bone Marrow
PNH	Paroxysmal Nectornal Hemoglobinuria

VII. PROGRAM ENTRY REQUIREMENTS

1. Admission to the program will be determined in accordance with the SCFHS's training rules and regulations. All trainees must abide by the training regulations and obligations established by the SCFHS.
2. Training is a full-time commitment; residents must be enrolled in full-time, continuous education for the entire duration of the program.
3. Applicants must meet the following requirements:
    - Be a graduate of a recognized medical school.
    - Be licensed by the SCFHS.
    - Have passed an admission examination and undergone an interview with the program's administration.
    - Have provided recommendation letters from three references.
    - Have provided a letter from a sponsoring organization (if required) demonstrating approval of the candidate for full-time training for the entire program period.

VIII. LEARNING AND COMPETENCIES

1. Introduction to Learning Outcomes and Competency-Based Education

Upon completion of training, residents must have acquired the following competencies and functional abilities per the framework outlining the competencies of the CANMEDS roles:

- Ability to demonstrate competence in the practice of hematopathology
- Ability to recognize and illustrate how to perform research
- Ability to acquire information about technology and new developments in the field of hematopathology
- Ability to identify the value of professionalism in dealing with colleagues, medical staff, and patients

The hematopathology residency program is designed to produce medical physicians with the skills needed to diagnose various malignant and non-malignant hematological disorders along with the skills necessary for blood banking and transfusion medicine and those needed to work as the director of a medical laboratory. To this end, administration skills are covered during the training. Candidates must demonstrate knowledge of research and practice by conducting research and publishing their findings during the training period. The curriculum will be covered during four years of rotations. The following are the fundamental learning objectives:

4. Remembering and recalling information related to recognizing, listing, describing, retrieving, and classifying data related to hematological diseases

5. Explaining the basic concepts and principles of the diagnostic criteria for the classification scheme of hematologic disorders/neoplasms
6. Applying and utilizing information to formulate differential diagnoses of hematologic disorders through the correlation and interpretation of morphology, clinical data, and relevant phenotypic/genotypic ancillary studies
7. Analyzing and assessing detailed morphologic evaluations and interpretations of peripheral blood smears, bodily fluid preparations and bone marrow aspirate, and biopsy and lymph node sections
8. Evaluating situations critically and using good judgment and sound rationale to arrive at a diagnostic interpretation in relation to hematological disorders and blood banking
9. Creating and generating new ideas, products, and ways of planning; designing policies; and developing skills in both the areas of routine diagnostic hematology and blood banking and research and development in relation to hematological diseases

In addition to the six fundamental learning objectives, trainees must acquire the following program-specific competencies:

10. Ability to understand workups of patients with anemia and utilize this information in proposing laboratory test selection to establish a diagnosis
11. Ability to provide interpretation and diagnosis for the immunophenotypic analysis of hematolymphoid malignancies, including immunohistochemistry technology, flow cytometry, and cytochemistry; ability to correlate data with histologic findings
12. Ability to recognize molecular diagnostic applications and the interpretation of hematologic lesions, including PCR, in-situ hybridization, conventional cytogenetics procedures, and fluorescent in-situ hybridization (FISH)

13. Ability to explain the use of molecular assays in the diagnosis of hematolymphoid disorders and malignancies
14. Ability to compare and correlate data with histologic findings; ability to describe the decisions involved in test selection
15. Ability to understand the principles of normal hemostasis and ultimately perform the procedures required for workups of patients with coagulopathies, including appropriate specimen collection and interpretation
16. Ability to develop and obtain proficiency/familiarity in interpretation regarding various coagulation procedures, including prothrombin time, activated partial thromboplastin time, thrombin time, fibrinogen determination, coagulation factor assays, coagulation factor inhibitor studies, fibrin-fibrinogen degradation product determination, bleeding time, platelet aggregation studies, special molecular assays, etc.
17. Ability to utilize this information in proposing laboratory test selection to establish a diagnosis
18. Ability to provide management/triage decisions regarding lymph node and/or extra nodal biopsies for possible use in ancillary studies, including flow cytometry, cytogenetics, paraffin immunohistochemistry, molecular/genotypic analysis, and/or tissue culture as indicated
19. Ability to write concise, informative, and comprehensive reports on specimens submitted for examination; ability to employ communication/liaison skills when discussing pertinent findings with submitting physicians, pathologists, and laboratory staff and serve as an effective consultant with clinicians
20. Ability to appraise the current literature and information in the field of hematopathology
21. Ability to analyze issues of quality assurance and lab administration related to hematology laboratories and recognize the importance of

participating in quality control procedures, automation/instrument operation, LIS, and lab management

22. Ability to demonstrate competence in the use of microscopic photography, including digital imaging technology, through active participation and presentation in conferences; ability to recognize one's role as an important member of the hematopathology diagnostic team and educator
23. Ability to carry out and engage in blood bank donor services activities including recruitment, collection, donor testing, production, and processing and engage with patient transfusion services, including immune-hematologic testing, red cell genotyping, and compatibility
24. Ability to recognize the role of cellular therapy activities such as stem-cell collection
25. Ability to recognize the role of clinical hematology services in both outpatient and inpatient settings to build knowledge about how to manage patients with hematological disorders
26. Ability to carry out and participate in research and demonstrate competencies in writing research proposals, data collection, analysis, and writing manuscripts
27. Ability to demonstrate knowledge of the normal morphology of hematopoietic cells and the basics of hemostasis
28. Ability to demonstrate knowledge of the normal histological structure of the tissues involved in hematopoiesis (bone marrow, lymph nodes, spleen, and thymus)
29. Ability to develop and demonstrate an understanding of all kinds of sample processing activities, from receiving to reporting
30. Ability to interpret the data obtained from blood smears, bone marrow biopsies, hemoglobin/protein electrophoresis, and platelet function assays
31. Ability to adopt a leadership and mentorship role in relation to junior residents

32. Ability to demonstrate comprehensive knowledge and practical experience in HLA typing
33. Ability to illustrate blood components and plasma protein products with their clinical indications
34. Ability to explain the basic principles of apheresis and clinical application
35. Ability to assess adverse reactions to blood products and their use in patient management

2. Program Duration

The Executive Council of Training and Education requires that four years of training be completed, as was outlined by the decree of the hematopathology residency program.

3. Program Rotation

1- Introduction:

This is a structured, four-year postgraduate residency training program in SB-HEMPATH. It is divided into two parts:

A. Junior residency (the first two years) and
B. Senior residency (the final two years).

The junior years (R1 and R2) are designed to provide training in basic pathology and general hematopathology, together with rotations in a special hematology laboratory, flow cytometry, and cytogenetics. The senior residency years (R3 and R4) are designed to provide advanced training in the morphology of blood, bone marrow, and lymph nodes with exposure to transfusion medicine (blood banks), molecular genetic pathology, and clinical hematology. Additionally, trainees are given the opportunity to expand on the knowledge and experiences gained in the first two years of their training.

- Residents are expected to do two blocks of four weeks each as elective rotations in their area of interest in the final two years of their training.
- The sequence of the rotations is organized by the regional training committee.
- Each resident must examine and assess at least 3,000 hematological cases exhibiting an adequate level of diversity (bone marrow 500, lymph node 50, blood film morphology and bodily fluids 1,000, special coagulation 400, hemoglobin electrophoresis 400, serum protein electrophoresis 50, flow cytometry 400, procedure for therapeutic plasma pheresis and platelet and other cellular collections 10 and 20 respectively, molecular and cytogenetics 200). This requirement ensures that trainees receive exposure to both common and uncommon conditions besides sharpening their critical diagnostic skills.
- Each resident must participate in at least 10 bone marrow aspirate/biopsy procedures during the senior years.
- Each resident must participate in at least two research activities, one as the first author and the other as a coauthor.
- Residents should be involved in on-call coverage during weekdays and weekends beginning in the first year of training.
- After successful completion of all program requirements throughout the four-year training period and after obtaining a final in-training evaluation report (FITER), the candidate will receive a training completion certificate.
- Candidates who successfully complete the final certification examination will be awarded a SB-HEMPATH certificate by the Saudi board.

2- Program rotation overview:

1. Bone marrow morphology (42 weeks over 4 blocks)
2. Peripheral blood and bodily fluid morphology (42 weeks over 4 blocks)
3. Blood banking and transfusion medicine (26 weeks over 4 blocks)
4. Clinical inpatient and outpatient settings (12 weeks)
5. Hemoglobinopathy and protein electrophoresis (8 weeks over 2 blocks)

6. Coagulation testing and reporting (8 weeks over 2 blocks)
7. Lymph node morphology (8 weeks over 2 blocks)
8. Molecular, cytogenetics, and flow cytometry (12 weeks over 3 blocks)
9. Elective rotations (8 weeks over two blocks)
10. Quality control and laboratory administration (4 weeks)

Table 1: Hematopathology Residency Rotations # (Blocks)							
R1 Rotation	Period	R2 Rotation	Period	R3 Rotation	Period	R4 Rotation	Period
Introduction to laboratory medicine	4 weeks	PBM and bodily fluid morphology service-2nd rotation	10 weeks	BM morphology service-3rd rotation	10 weeks	Transfusion medicine-3rd rotation	10 weeks
Basic hematology /morphology	8 weeks	Flow - cytometry	4 weeks	Adult clinical hematology and pediatric clinical hematology	12 weeks	Elective 2	4 weeks
Introduction to anatomical pathology lab	4 weeks	BM morphology service-2nd rotation	10 weeks	Elective 1	4 weeks	Lymph node morphology -2nd rotation	4 weeks
Basic blood bank and lab quality management	4 weeks	Cytogenetics*	4 weeks	Molecular genetics	4 weeks	PBM and bodily fluid morphology services-4th rotation	10 weeks
Basic coagulation	4 weeks	Electrophoresis serum/hemoglobin reporting-1st rotation	6 weeks	Special coagulation-1st rotation	4 weeks	BM morphology services-4th rotation	12 weeks

PBM and bodily fluid morphology services-1st rotation	12 weeks	Transfusion medicine-1st rotation	10 weeks	PBM and bodily fluid morphology service-3rd rotation	10 weeks	Special coagulation-2nd rotation and lab administration	4 weeks
BM morphology services-1st rotation	12 weeks	Lymph node morphology-1st rotation	4 weeks	Transfusion medicine-2nd rotation	4 weeks	Electrophoresis serum/hemoglobin reporting-2nd rotation	4 weeks
Total weeks	48		48		48		48
Leaves	4 weeks each year						
# Each rotation depends on feasibility and program director approval; the rotations listed are not necessarily to be completed in a sequential fashion.							

Training Year	Mandatory core rotations*			Elective rotations**			Selective rotations***		
	Rotation name	Duration	Setting	Rotation name	Duration	Setting	Rotation name	Duration	Setting
R1	1-Introduction to laboratory medicine 2-Introduction to anatomical pathology lab 3- Basic hematology and morphology 4-Basic coagulation 5- Lab quality management 6- Basic blood bank principles 7- PBM and body fluid morphology services 8- PBM and bodily fluid morphology services	4 4 10 4 4 12 12	Lab and blood bank	NO		Lab and blood bank	No		
R2	1-PBMand body fluid morphology services 2- Flow cytometry 3- BM morphology services 4- Cytogenetics 5- Hemoglobinopathy laboratory 6- Electrophoresis reporting serum/hemoglobin-1st rotation 7- Transfusion medicine I 8- Lymph node morphology	10 4 10 6 4 10 4	Lab and blood bank	NO		Lab and blood bank	No		
R3	1-BM morphology services 2- Clinical hematology 3- Elective 4- Molecular genetics 5- Special coagulation laboratory 6- Special coagulation reporting 7-PBM and bodily fluid morphology services 8 Transfusion medicine-2nd rotation	10 12 4 4 4 12 4	•	YES	4 weeks	Lab/ blood bank /clinical	• • •		

R4	1-Transfusion medicine II 2- Elective 3- Lymph node morphology 4- PBM and bodily fluid morphology services 5- Special coagulation reporting 6- BM morphology services 7- Lab administration 8- Hemoglobinopathy reporting	10 4 4 10 4 12 4	• L	YES • •	4 weeks	Lab/ blood bank / clinical	• • •		

4. Mapping of Learning Objectives and Competency Roles to Program Rotations

Refer to Appendix B

Rotation Descriptions and Objectives:

1) Introduction to laboratory medicine (over 4 weeks):

The field of laboratory medicine in general and hematopathology specifically is not well-known, and medical students usually do not possess enough knowledge about the categorization and functionality of the persons working in this field. The first rotation is intended to expose residents to the various sections and functions of laboratory medicine, including the following:

a- Blood collection using various tubes and sample transportation and processing methods at various laboratories.

b- Core laboratory skills with exposure to clinical biochemistry, serology (both infectious and immune), and routine and special microbiology.

Competencies:

1.1 Understand sample-collection techniques

1.2 Differentiate between the types of blood-collection tubes

1.3 Identify problems with the collection, transportation, and processing of samples

1.4 Understand preanalytical procedures

1.5 Recognize the methods/instruments required for core laboratory practices

1.6 Develop clinical problem-solving skills, especially in relation to discrepancies between clinical presentation and lab tests in biochemistry

1.7 Recognize the various methodologies used in infectious disease detection and immunoserology with exposure to and understanding of the ELISA technique

Knowledge:

Each resident is expected to understand how to evaluate the quality of samples and their importance for making an accurate diagnosis as well as the effects of various factors on the integrity of samples.

2) Introduction to anatomical pathology laboratory (over 4 weeks):

Histopathology is an integral part of hematopathology work, and trainees must acquire knowledge of cutting lymph nodes and other tissues as well as processing tissues, including bone marrow fixation, declassification, and staining. During the four weeks of this rotation, the resident is expected to attend the histopathology morning rounds to gain exposure to how to read the standard staining and learn about the integration of clinical presentation with morphological changes and the use of research like immunohistochemistry, cytogenetics, and (sometimes) molecular studies in diagnosing various disorders that require tissue diagnosis. During this rotation, it is expected that the resident will gain exposure to electron microscopy if possible.

Competencies:

1.1 Identify how to cut specimens submitted for tissue processing

1.2 Understand various methods of tissue fixation

1.3 Understand slide staining by H&E

1.4 Recognize various immunohistochemistry techniques

1.5 Expand one's knowledge in anatomical pathology case discussions and MDT meetings

Knowledge:

The resident is expected to understand the basics of anatomical pathology and the required testing procedures for his/her future work in hematopathology.

3) Basic hematology/morphology (over 10 weeks):

Learning basic hematology/morphology is an important step in training candidates because this topic provides an introduction to the hematology laboratory, and it is their first exposure to learning about the various available types of instrumentation and appropriate technologies for a specific laboratory.

Competencies:

1.1 Understand the principles of automated hematology analyzers and staining

1.2 Understand the principles of erythrocyte sedimentation equipment

1.3 Identify the components of light microscopy, including phase contrast and microscopy, for crystal polarized microscopy

1.4 Prepare a stained peripheral blood/bodily fluid film and supra vital stains

1.5 Learn how to read a peripheral blood film for various body fluids

1.6 Learn how to do a manual differential count

Knowledge:

1.1 Selection of the most appropriate automated hematology analyzer for the laboratory based on clinical need while considering its validation, setup, calibration, reagent usage, quality control, troubleshooting, maintenance, and service issues

1.2 Development of normal reference ranges

1.3 Selection of the most appropriate automated staining machines while considering their validation, setup, reagent usage, quality control, troubleshooting, maintenance, and service issues

1.4 Selection of erythrocyte sedimentation equipment while considering its validation, setup, reagent usage, quality control, troubleshooting, maintenance, and service issues

1.5 Manual preparation of a peripheral blood smear, including smearing and staining with Wright-Giemsa stain

1.6 Preparation of thick and thin blood films for malaria and other parasites

1.7 Manual preparation of supra vital stains

1.8 Manual leucocyte/platelet counts using a chamber counter

1.9 Manual platelet estimates

1.10 Manual reticulocyte counts

1.11 Visualization of crystals using phase contrast microscopy

1.12 Performance of a differential count on peripheral blood/bodily fluid films

4) Basic and special coagulation (over 10 weeks):

The coagulation system is one of the most complicated and sophisticated body systems, as it tightly balances the interactions between the large numbers of proteins that induce hemostasis and thrombosis. Many disorders result from a disturbance of this delicate balance due to either a deficiency of one or more of these proteins (factors) or a loss of function or clearance due to the presence of acquired antibodies or autoantibodies. The involvement of a hematopathologist in the diagnosis and management of these disorders is crucial, and they require daily management, regardless of the level of care: primary, secondary, or tertiary.

During the first year, the resident gets his/her initial exposure to the coagulation laboratory, where he/she gets to know the types of samples and collection tubes that are required for various coagulation tests. Trainees are expected to demonstrate the following:

a- Exposure to routine coagulation tests, including PT, PTT, Fib, and D Dimer

b- Knowledge of the various methodologies

c- Exposure to routine platelet functional tests, like PFA100

Competencies for Basic Coagulation:

1.1 Recognize the pre-analytical errors that affect the various coagulation tests

1.2 Identify the principles of various coagulometer techniques

1.3 Carry out manual PT and PTT

1.4 Understand the principle of mixing studies

The resident is expected to participate again in the coagulation lab in R2 and R4; during both rotations, which take place over 4 weeks each, he/she becomes exposed to all the special coagulation tests for Studying thrombophilia and bleeding disorders as well as methods of monitoring various anticoagulation and hemostatic drugs. Trainees must participate in clinical services and conduct various special coagulation tests under supervision.

Competencies for special coagulation:

1.1 Understand all factor assays covered by the one stage and chromogenic factor assay (FII-FXIII)

1.2 Recognize how to detect factor inhibitors with exposure to techniques for conducting Bethesda assays

1.3 Understand the methods of measuring natural anticoagulants (proteins C and S and antithrombin) and conducting both antigenic and functional assays

1.4 Perform tests for measuring platelet functions, including various platelet aggregation methods

1.5 Understand various antiphospholipid tests, including lupus anticoagulants, anti-cardiolipin, and Beta 2 glycoprotein

1.6 Recognize tests for von Willebrand disease

1.7 Illustrate various direct anticoagulation drugs

1.8 Recognize heparin-induced thrombocytopenia tests

1.9 Recognize the measurement of thrombin time and reptilase time

1.10 Understand the measurement of the anti-factor Xa for drug levels

1.11 Analyze and interpret various test reports on a daily basis during the coagulation rotation under supervision

Knowledge:

The resident is expected to understand the principles of coagulation systems and the changes that occur with various inherited and acquired conditions as follows:

1- Know how to diagnose coagulation factor deficiencies like hemophilia A and B and differentiate between various levels of clinical severity and become involved in the diagnoses of such disorders while being aware of the technical problems that may affect the diagnosis or measurement of their levels and appreciating the physiological changes that may affect a patient's levels

2- Understand the various platelet disorders and how to diagnose them using various methodologies and use various lab methods to make the appropriate diagnosis

3- Understand thrombophilia and the various causes of thrombosis, both inherited and acquired, and demonstrate the ability to diagnose these conditions

4- Understand the effects of various anticoagulants on blood samples and coagulation tests

5- Integrate clinical and laboratory findings

6- Interact with clinical colleagues to resolve issues related to hemostasis and thrombosis

5) PBM and bodily fluid morphology (over 42 weeks):

This is one of the most important rotations that clinical service residents complete during their four years of residency, as it gives them the knowledge and experience to practice as specialists in hematopathology and represents around 20% of all rotations.

The examination of a stained blood film is an essential part of any hematological investigation. A lot of diagnostic information can be obtained by a systemic examination of a well-spread, well-stained peripheral blood smear. At times, it may be the only test needed in a scenario. All three major cellular components of blood, red cells, white cells, and platelets, demonstrate some helpful, if not always diagnostically conclusive, features when various types of hematological disorders are present. Peripheral blood films also constitute an important investigation method in bone marrow evaluations, and they are always examined in combination with bone marrow smears and biopsies.

Similarly, a morphologic examination of cytocentrifuge preparations of different body fluids, including pleural, peritoneal, pericardial, bronchial lavage, synovial, vitreous, and cerebrospinal fluids (CSF), is part of assessing derangements of blood cells and other abnormalities when testing for various hematological and non-hematological diseases. Along with the interpretation of CBC, a hematopathology trainee must be familiar with the interpretation of peripheral blood smears and the bodily fluids of both pediatric and adult specimens.

Competencies:

By the end of the rotation in peripheral blood and bodily fluid morphology, trainees should be able to do the following:

1.1 Understand the uses and limitations of peripheral blood smears and bodily fluid preparations in hematopathology as an ancillary diagnostic tool

1.2 Utilize essential and accurate information regarding patients being evaluated, including the clinical history and previous results of relevant laboratory investigations

1.3 Perform a peripheral blood smear systematically, beginning with the macroscopic observation of a stained film and then progressing from a low- to high-power microscopic examination

1.4 Interpret and dictate a comprehensive peripheral blood smear report, which includes microscopic descriptions, interpretations, and recommendations, in all cases if needed

1.5 Utilize good judgment regarding when to ask for help during the evaluation of peripheral smears and bodily fluid reviews

1.6 Communicate clearly and in a timely manner when needed to inform clinicians, clinical residents, and hematology and oncology trainees of appropriate testing and triaging

1.7 Perform a morphologic analysis of bodily fluid preparations and correlate it with the cell count and clinical indications

1.8 Perform quality control (QC) of the staining and assess the quality of the preparation of the blood smear or cytocentrifuge

Knowledge:

The hematopathology trainee should have good grasp of the following suggested topics when progressing through the peripheral blood and bodily fluid rotation:

A. Peripheral blood smear

1. Iron deficiency anemia
2. Megaloblastic anemias (vitamin B_{12} or folate deficiency)
3. Hemolytic anemias
4. Sickle cell disease
5. Hemoglobinopathies other than sickle cell disease
6. Thalassemia Chédiak-Higashi syndrome
7. May-Hegglin anomaly
8. Pelger-Huet anomaly
9. Alder-Reilly anomaly
10. Glucose-6-phospate dehydrogenase (G6PD) deficiency
11. Pyruvate kinase deficiency and other red cell enzymopathies
12. Hereditary spherocytosis
13. Hereditary elliptocytosis and poikilocytosis
14. Southeast Asian ovalocytosis
15. Malaria
16. Immune thrombocytopenic purpura
17. Thrombotic thrombocytopenic purpura (TTP)
18. Leukoerythroblastic blood picture
19. Myelodysplastic syndromes (MDS)
20. Hairy cell leukemia
21. Acute lymphocytic leukemia
22. Acute myeloid leukemia (AML)
23. Chronic myeloid leukemia
24. Chronic myelomonocytic leukemia
25. Chronic lymphocytic leukemia (CLL) and prolymphocytic transformation
26. T-cell prolymphocytic leukemia
27. Peripheralization of malignant lymphoma cells
28. Myeloid shift to immaturity

29. Artifacts: pseudothrombocytopenia due to clumping and platelet satellitosis
30. Abnormal platelet morphologic features (e.g., May-Hegglin and gray platelet syndrome)

B. Bodily fluids:

1. Acute leukemia or blasts (lymphocytic and myeloid)
2. Malignant lymphoid cells
3. CSF infection/shunt changes
4. Central nervous system tissues: neuroglia, choroid plexus, and ependymal cells.
5. Bone marrow contamination of CSF
6. Malignant versus reactive tissues and mesothelial cells in ascitic and pleural fluids

6) Bone marrow morphology (over 42 weeks):

This is one of the most important rotations that clinical service residents complete during their four years of residency, as it gives them the knowledge and experience to practice as specialists in hematopathology and represents around 20% of all rotations.

Bone marrow examination and evaluation is one of the core areas that are fundamental to hematopathology practice. This area encompasses diagnostic examinations that cover a wide variety of benign, reactive, and malignant conditions. The goal for trainees is to learn to recognize morphologic abnormalities and subtle diagnostic clues in the blood, marrow aspirates, and bone marrow biopsy specimens of patients and incorporate appropriate ancillary test data in formulating differential and final diagnoses. Having sound knowledge of bone marrow is crucial for recognizing and diagnosing a wide array of hematopathologic conditions, such as myeloproliferative neoplasms (MPNs), myelodysplastic conditions

(MDSs), lymphoproliferative disorders (like CLL/SLL), acute leukemias, metastatic neoplasms, bone marrow failure syndromes, anemias, and a host of reactive conditions as well as conducting post-chemotherapy bone marrow status assessments.

Competencies:

By the end of this rotation, the resident should be able to do the following:

1. Understand the role of bone marrow as a tool for diagnosing various hematological and medical disorders and refer to the pertinent clinical information and indications for performing bone marrow procedures
2. Evaluate CBC counts and peripheral blood specimens, bone marrow aspirates, and biopsy specimens
3. Assess Wright-Giemsa-stained BM smears or touch imprints from BM cores and H&E-stained sections of biopsy specimens
4. Perform BM aspirate differential counts
5. Perform triaging of bone marrow specimens for ancillary testing (e.g., cytogenetics, flow cytometry, special histochemical or immunohistochemical stains, microbiology studies, and molecular pathology tests) as necessary based on the clinical context and initial bone findings
6. Summarize a patient's clinical presentation and incorporate additional test results from the clinical laboratory (e.g., lactate dehydrogenase and serum protein levels)
7. Specify the ancillary testing, such as flow cytometry and molecular diagnostics, that should also be considered and incorporated into the diagnostic workup
8. Present BM cases during MDT
9. Demonstrate the ability to communicate and collaborate with the clinical hematology department and other healthcare teams or referral services/clients to discuss bone marrow reports when needed
10. Demonstrate the ability to write comprehensive bone marrow reports

11. Demonstrate the ability to utilize technology to enhance communication

Knowledge:

Residents should master the related knowledge, including bone marrow manifestations and workups of the following neoplastic and non-neoplastic disorders, during their bone marrow rotation:

A. Reactive and nonneoplastic conditions

1. Anemias, not otherwise specified
2. Iron deficiency, vitamin B_{12} or folate deficiency, hemolytic anemia, and anemia of chronic disease
3. Erythrocytosis and secondary polycythemia
4. Leukocytosis, leukemoid reaction, and toxic changes
5. Reactive bone marrow with a shift to immaturity
6. Post-chemotherapy marrow changes
7. Post-stem cell transplantation bone marrow recovery
8. Myeloid growth factor effects (G-CSF)
9. Eosinophilia, basophilia, monocytosis, and lymphocytosis
10. Reactive viral and parasite and organism identification in bone marrow
11. HIV-associated changes and granulomatous conditions (e.g., sarcoid)
12. Bone changes and fibrosis associated with hyperparathyroidism and renal disease
13. Aplastic anemia and bone marrow failure syndromes
14. Megakaryocytic numbers and morphologic features in conjunction with thrombocytosis or thrombocytopenia

B Neoplastic conditions

1. Myeloproliferative neoplasm (MPN)
    a. chronic myeloid leukemia
    b. Myelofibrosis
    c. Polycythemia vera

d. Essential thrombocytosis

e. Triple-negative MPN

2. Myelodysplastic/myeloproliferative neoplasms (MDS/MPN)
3. Myeloid neoplasm associated with eosinophilia
4. MDS with definitions of all WHO sub-types (2017)
5. Acute myeloid leukemia (AML)
    a. AML with recurrent cytogenetic abnormalities
    b. AML with multilineage dysplasia
    c. AML and MDS, therapy-related
    d. AML, not otherwise categorized
    e. Acute leukemia of ambiguous lineage
6. Blastic plasmacytoid dendritic cell neoplasms
7. Myeloid neoplasms with germline predisposition
8. Lymphoid neoplasms
    a. Precursor T-cell leukemia/lymphoma
    b. Precursor B-cell leukemia/lymphoma
    c. Mature B-cell neoplasms involving bone marrow
    d. Mature T- and natural killer (NK)-cell neoplasms involving bone marrow
    e. Post-transplant lymphoproliferative disorder (PTLD)
    f. Hodgkin's lymphoma manifestation in bone marrow
    g. Neoplasms of uncertain lineage and stages of differentiation
9. Histiocytic and dendritic-cell neoplasms
10. Metastatic tumors
11. BM necrosis (secondary to tumor, leukemia, or embolic events)

7) Basic blood bank principles and transfusion medicine (over 26 weeks):

These are some of the most important rotations that clinical service residents complete during their four years of residency, as they give them

the knowledge and experience to practice as specialists in hematopathology with general knowledge in the field of blood banking and transfusion medicine. They represent around 15% of all rotations.

Transfusion services include diagnostic services, such as diagnosis of immune hemolytic anemia, hemolytic disease of newborns, and estimations of antibody titers; however, the main function of transfusion services is to ensure delivery of the most suitable, safest blood/blood product to the correct patient in a timely manner. This process spans multiple steps, beginning with collecting the blood/blood product from a "safe" donor and progressing to transfusing patients with the most suitable blood/blood products to improve their clinical outcomes with multiple steps taken to ensure the safety and suitability of the products. Transfusion services include other therapeutic services, including therapeutic apheresis, RBC exchanges, and stem cell collection.

As it is such a critical service, transfusion services must comply with the KSA's standards for blood banking to ensure the safety of the blood supply and appropriateness of the transfusion services offered to patients. To go a step further, many blood banks seek non-compulsory international accreditation to ensure the highest standards of practice.

In the introductory rotation, the resident is exposed to the various areas of transfusion services and the tests performed in this context. Trainees learn the theoretical and practical aspects of blood grouping, antibody detection, and identification and blood cross-matching. Each resident undergoes two 10-week rotations in R2 and R4; these rotations provide the time and opportunity for trainees to develop well-rounded knowledge and gain hands-on experience when addressing all issues related to blood donation, therapeutic apheresis, resolution of blood-grouping discrepancies, and maintenance of the standards of the service.

The stem cell laboratory is concerned with the collection, processing, storage, and transfusion of stem cell products. In most of the services, the

stem cell lab is part of transfusion services, and the hematopathologists require extra training to direct the work at the stem cell laboratory. Two weeks of the R2 or R4 rotation must be spent in a stem cell lab.

Competencies:

1. Examine and appraise the operation of transfusion services
2. Assess donor acceptability
3. Manage donor reactions and perform donor counseling
4. Determine blood group discrepancies and provide advice on the appropriate products for transfusion
5. Investigate transfusion reactions and give recommendations regarding future transfusions
6. Provide therapeutic apheresis consultation services and select the most suitable replacement fluids
7. Audit the blood bank

Knowledge:

Upon completion of training, the resident should possess the following abilities:

1. Know the various blood group antigens and their clinical significance and relevance
2. Know how to perform blood grouping and extended phenotyping
3. Know how to detect and identify antibodies
4. Assess the suitability of blood/blood product orders
5. Know how to investigate cases of hemolytic anemia and integrate various laboratory tests to reach a conclusion
6. Know how to investigate suspected hemolytic diseases in newborns
7. Know the various types of transfusion reactions and the workups required to identify the possible etiologies and provide advice on the steps to be taken to prevent recurrence

8. Know the indications of therapeutic apheresis and how to select the correct type of replacement fluids and volume
9. Monitor the blood inventory to ensure adequate supplies
10. Know the acceptance and rejection criteria for blood donors and possess the ability to manage donor reactions and perform donor counseling when needed
11. Have adequate knowledge of the national standards for safe blood banking
12. Participate in transfusion management committee meetings
13. Participate in internal/external auditing of transfusion services

8) Lymph node morphology (over 8 weeks):

Evaluation of lymph nodes and extra nodal lymphoid tissues other than bone marrow for involvement in lymphoma or other hematolymphoid processes is usually a significant component of hematopathology training. Although trainees are not expected to independently diagnose and report cases of lymphoma in surgical specimens, it is important that hematopathology trainees become well-versed in lymphoma pathology owing to the wide variety of benign and neoplastic lymphoid lesions encountered in day-to-day hematopathology practice.

Competencies:

1. Understand the normal anatomy, histology, and pathophysiology of lymph nodes, the spleen, and the thymus
2. Assess gross examinations of lymph nodes and the related structures and perform touch preparations and selection of histologic sections
3. Choose and triage specimens for appropriate ancillary testing (e.g., cultures, flow cytometry, and cytogenetic and molecular testing) for diagnosis of tissue-based hematolymphoid disorders

4. Follow a specimen through to diagnosis, integrating the data collected with clinical manifestations, gross pathologic features, and morphologic impression
5. Recognize the abnormal (pathological) changes seen in hematolymphoid disorders and reactive processes and other primary and metastatic tumors that involve the lymph nodes, spleen, and thymus
6. Identify the relevant immunohistochemical stains for all lymph node cases – from in house or referred cases
7. Formulate and dictate a diagnostic report with the incorporation of all ancillary data used in the formulation of the final reported diagnosis

Knowledge:

It is necessary to develop a knowledge base that includes the clinical entities, ancillary testing (i.e., flow cytometry, immunohistochemical and special stains, and cytogenetic and molecular studies), and morphologic features of many benign and malignant processes that involve lymph nodes and the related organ (spleen).

The curriculum topics in which the trainee should be well-versed include the following:

A. Benign nodal diseases

1. Reactive lymphadenopathies (follicular hyperplasia, sinus histiocytosis, PTGC, marginal zone hyperplasia)
2. Infectious lymphadenitis
    a. Viral lymphadenitis, including manifestations of AIDS
    b. Bacterial lymphadenitis
    c. Mycobacterial lymphadenitis
    d. Fungal lymphadenitis
    e. Protozoal lymphadenitis
3. Lymphadenopathies associated with clinical syndromes

a. Kimura lymphadenopathy
b. Rosai-Dorfman disease
c. Kikuchi-Fujimoto lymphadenopathy
d. Sarcoidosis lymphadenopathy
e. Systemic lupus lymphadenopathy
f. Rheumatoid lymphadenopathy
g. Dermatopathic lymphadenopathy
h. Langerhans' cell histiocytosis
i. Castleman lymphadenopathy
j. Hemophagocytic syndrome

4. Iatrogenic lymphadenopathies (drug-induced, phenytoin, etc.)
5. Vascular lymphadenopathies
6. Foreign body lymphadenopathies and lymph node inclusions

B. Malignant tumors/lymphomas

1. Classical Hodgkin lymphoma and subtypes
2. Lymphocyte-predominant Hodgkin lymphoma
3. Precursor B- and T-cell neoplasms
4. Mature B-cell neoplasms
5. Mature T-cell and NK-cell neoplasms
6. Granulocytic, histiocytic, and dendritic-cell neoplasms
7. Mastocytosis
8. Recognition of lymphoproliferative disorders associated with immune deficiencies
   a. Primary immune deficiencies
   b. Post-transplant lymphoproliferative disease
   c. Acquired immunodeficiency disease
9. Recognition of spindle cell, vascular, and metastatic neoplasms in lymph nodes

Diagnostic entities and pathologic processes that involve the spleen that should be included in the curriculum and include the following:

A. Hypersplenism and hyposplenism

B. Extramedullary hematopoiesis

C. Disorders of the white pulp (reactive lymphoid hyperplasia, granulomatous disorders, amyloidosis, Hodgkin lymphoma, lymphomatous involvement of the spleen: primary and secondary)

D. Disorders of the red pulp (storage diseases, histiocytosis, gangliosidosis, hemophagocytic syndrome, hairy cell leukemia, myelofibrosis, and various chronic leukemias)

As hematolymphoid malignancies may involve extra-nodal sites and some of these malignancies have an increased propensity for extra-nodal involvement or manifestations (e.g., extra-nodal marginal zone lymphomas (MALT), splenic marginal zone lymphomas, enteropathy-associated T-cell lymphomas, NK/T-cell type lymphomas, nasal types, mycosis fungoides, Sezary syndrome, primary cutaneous CD30+ lymphoproliferative disorders, primary mediastinal large B-cell lymphomas and other thymic lymphomas, subcutaneous panniculitis-like T-cell lymphomas, etc., it is essential that hematopathology residents be knowledgeable about the evaluation of extra-nodal tissues for diagnosing hematolymphoid malignancies.

9) Lab quality management and laboratory administration (over 4 weeks):

The role of the hematopathologist extends beyond laboratory diagnosis. Pathologists must manage laboratory resources efficiently to ensure the best results for patients and ensure the sustainability and consistency of treatment performance. Hematopathology residents must build their knowledge in this specialized area through structural studies and active participation in the implementation of the various elements of the

comprehensive quality management system. The training center must ensure that trainees receive adequate exposure and that they participate in the quality-management process.

Competencies:

1. Analyze quality-control data and apply the appropriate acceptance rules for the relevant tests
2. Assess new instruments/tests
3. Design instrument/test validation plans
4. Select the most suitable test/instrument for patient testing
5. Perform an audit of the laboratory according to a set of pre-defined standards
6. Analyze variances and design a process for performance improvement
7. Understand the essentials of change management

Knowledge:

Each resident must be familiar with the elements of the laboratory quality management system and apply the quality standards throughout the training period. The following are the basic objectives:

1. Understand the role and importance of quality control (QC) for laboratory testing and interpretation of the QC data
2. Understand the role of external proficiency testing and its value in standardization of laboratory performance
3. Understand the concepts and importance of performance variance, risk assessment, and process improvement in ensuring optimal results for patients
4. Perform instrument/test assessments and validation
5. Recognize national/international accreditation requirements and standards through active participation in laboratory accreditation preparation and auditing

10) Clinical hematology services (over 12 weeks):

The hematology clinical rotations in both adult and pediatric clinical services are meant to give trainees broad-based experience in all the aspects of clinical hematology that can enlighten hematopathology residents by providing them with the background needed to make an accurate diagnosis of various hematological disorders. The program emphasizes a clinicopathologic, integrated approach in the management of hematological disorders. There are two rotations designed to enable residents to gain exposure to various activities related to adult and pediatric clinical hematology.

Competencies:

Residents should acquire the following abilities:

1. Recognize the various clinical presentations of malignant and benign hematological disorders
2. Perform various procedures during the management of these disorders
3. Perform bone marrow procedures
4. Recognize and identify various chemotherapy drugs and protocols
5. Attend both inpatient rounds and outpatient clinics
6. Recognize and identify the process of bone marrow transplantation, including bone marrow stem cell collection

Knowledge:

After attending clinical activities in both adult and pediatric hematology, residents should be able to differentiate between various clinical presentations for benign and malignant hematology.

1. Practice bone marrow aspiration and procedures in a sufficient quantity to enable acquisition of the necessary knowledge and skills
2. Understand the various chemotherapy protocols and be aware of the needed post-chemotherapy laboratory information and the information needed during follow-ups with leukemia patients and understand the

value of minimal residual disease for follow up of various other malignant hematological disorders

3. Understand the value of CSF interpretation for the management of leukemia
4. Understand the presentation of bleeding disorders and how to manage bleeding episodes and monitor responses to various treatments
5. Understand how to diagnose thrombosis clinically and manage patients as well as monitor anticoagulation drugs
6. Understand the management of hemoglobinopathies
7. Understand the management of bone marrow failure disorders
8. Understand how to manage iron deficiencies
9. Understand the management of autoimmune hemolytic anemias
10. Understand the preparation for, and steps in, bone marrow transplantation

11 Flow cytometry (over 4 weeks):

While most of the interpretive teaching and indications for flow cytometric immunophenotypic testing occur during the rotations for bone marrow and lymph node sign outs, this rotation is intended to expose the resident to the laboratory-related and technical aspects involved in these studies. Residents will acquire knowledge and skills that will help them use this technique for diagnosing various malignant and some benign hematological disorders more effectively. To provide accurate interpretations, residents must have an understanding of the technical aspects of flow cytometric testing, including compensation, quality control, quality assurance, and the evaluation of new antibodies or staining methods.

Competencies:

1- Demonstrate the ability to differentiate between various flow cytometry methodologies and techniques

2- Develop an understanding of how analytical software is used to aid in interpretation and review the benefits of gating concepts/strategies versus cluster analysis and other applicable methods
3- Demonstrate the ability to use software for gating various cells
4- Demonstrate the ability to interpret flow cytometry evaluations and recognize most of the neoplastic and non-neoplastic disorders that involve bone marrow, tissue samples, blood samples, and bodily fluid samples
5- Demonstrate an understanding of the diagnostic limitations of flow cytometry when used in the absence of other diagnostic data, such as that related to tissue morphology, bone marrow aspirate smear morphology, and properly conducted blood smears or fluid cytologic preparations
6- Demonstrate an understanding of some of the testing methods specific to the flow cytometry laboratory and how such tests are used in providing patient care (i.e., PNH testing and lymphocyte subset testing)
7- Understand how flow cytometry can be used to assess minimal residual disease

Knowledge:

Residents will acquire knowledge about the principles of flow cytometry, related techniques, and the utilization and limitations of these techniques and instruments, as follows:

1- Be able to interoperate and diagnose various types of leukemia
2- Understand the gate for minimal residual disease
3- Diagnose paroxysmal nocturnal hemoglobinuria (PNH)
4- Interpret data regarding lymphomas
5- Interpret immunological tests, like those for lymphocyte subsets
6- Recognize and diagnose inherited platelet disorders using flow cytometry
7- Develop knowledge about and quantify the use of stem cells for bone marrow transplantations

11) Cytogenetics (over 4 weeks):

Cytogenetics (karyotype/FISH) is an integral part of the diagnosis of many benign and malignant hematological diseases, including acute lymphoid/myeloid leukemias, chronic myeloid/lymphoid leukemias, myeloproliferative neoplasms, myelodysplastic syndrome, myelomas, and others.

Knowledge:

a- Karyotyping

b- Fiuorescence in-situ hybridization (FISH)

Competencies:

1.1 Perform a karyotype test, including sample processing, cell cultures, harvesting, and slide preparation and staining

1.2 Perform FISH studies, including sample processing, cell cultures, harvesting, and slide preparation and staining

1.3 Interpret data related to karyotypes for various hematological diseases

1.4 Interpret FISH results for various hematological diseases

12) Hemoglobinopathy and protein electrophoresis testing and reporting (over 8 weeks):

During this rotation, the resident will gain exposure to various laboratory settings and tests, including the following:

A. Hemoglobinopathy testing and reporting

Inherited hemoglobinopathies, RBC enzymopathies, and RBC membrane defects are the main etiologies for anemia due to premature RBC destruction (hemolytic anemia) all over the world, especially in Saudi Arabia. Sickle cell anemia and thalassemia are prevalent in Saudi Arabia and achieving an accurate diagnosis is important for making major lifestyle and treatment decisions.

Competencies:

At the end of the training, the hematopathology resident should be able to do the following:

1. Select the most appropriate tests for making workups and diagnosing possible inherited hemolytic anemia
2. Write accurate diagnostic reports integrating data from various tests
3. Advise others on further tests that may be necessary beyond the basic hematological tests that are required for providing clinical/genetic counseling to patients

Knowledge:

The resident must demonstrate the following:

1. Theoretical knowledge of the genetic mutations, phenotypic presentations, and treatment options for the most common hemoglobinopathies, RBC enzymopathies, and RBC membrane defects
2. Hands-on skills in the performance of the tests used for hemolytic anemia workups
3. Understanding of the concepts of testing and the ability to compare the performance characteristics and limitations of the various testing methodologies/instruments
4. The ability to accurately interpret the outcomes of other related laboratory tests
5. Familiarity with options for genetic testing for these disorders

B. Serum protein electrophoresis and assessment of monoclonality:

Monoclonal gammopathy is frequently encountered in cases of B-cell lymphoma, and it is one of the criteria for the diagnosis of plasma cell malignancies. Serum protein electrophoresis and determination of the presence of monoclonal proteins are usually reported by a clinical pathologist or an immunologist; however, the hematopathologist is expected to be familiar with the nature and outcome of the tests and

integrate the results with the flow cytometry results and the peripheral blood and bone marrow-related morphological findings.

Competencies:

1. Interpret the results of serum protein electrophoresis, immunofixation studies, and other related reports
2. Integrate the findings of these studies with other hematological, flow cytometry, cytogenetic, and molecular results in the diagnosis of bone marrow studies.

Knowledge:

1. The resident must be familiar with the concepts underlying the tests and the various methodologies
2. The resident must be familiar with the various components related to serum protein and the reporting standards
3. The resident must understand the classification and diagnostic criteria of B-cell lymphomas and plasma cell diseases
4. The resident must integrate the results of protein electrophoresis and apply the diagnostic criteria in bone marrow reporting

13) Molecular genetics (over 4 weeks):

Currently, the field of hematopathology is rapidly moving toward molecular testing to diagnose and define disease entities. There has been considerable development of the understanding of the molecular basis of both inherited and acquired hematological disorders, and there are several ways in which this knowledge is being applied in diagnostic hematology. These include the identification of genetic defects in hemoglobinopathies, allowing the provision of early prenatal diagnoses, assessment of genetic risk factors in thrombophilia, diagnosis and characterization of leukemias, monitoring of minimal residual disease, and study of host-donor chimerism following bone marrow transplantation. Hence, it is indispensable for trainees to have

a basic understanding of molecular pathologic tests and their uses, limitations, and costs.

Competencies:

1. Develop an understanding of the basic molecular biology concepts that are pertinent to the practice of hematopathology
2. Understand the uses and limitations of molecular testing in hematopathology as an ancillary diagnostic tool
3. Learn about the interpretation of the common molecular tests required in the diagnosis, classification, and prognostication of hematological disorders
4. Learn how to incorporate appropriate molecular pathology data and results in the final versions of bone marrow and lymph node pathology reports
5. Differentiate between the false-negative and false-positive results of molecular biology procedures
6. Understand the processing of specimens, handling of fresh and fixed specimens, and methods of determining the quality of extracted DNA and RNA and molecular tests such as polymerase chain reaction (PCR), reverse transcription-PCR, real-time PCR, and PCR product detection (capillary electrophoresis)

Knowledge:

The topics to be addressed during training in molecular hematopathology include the following:

I. Basic concepts in molecular biology and pathology

A. Structure of nucleic acids: DNA and RNA (messenger RNA, ribosomal RNA, transfer RNA, and microRNA)

B. Basic gene structure and function

1. Promoters and enhancers
2. Pseudogenes

3. Transcription
4. Polyadenylation
5. RNA editing
6. Translation and amino acid synthesis
7. Frame shift mutations
8. Epigenetic effects
9. Methylation of DNA
10. Histones

II. Molecular pathology tests pertinent to hematopathology

1. Immunoglobulin heavy chains and T-cell receptor gene rearrangement by PCR and the use of BIOMED-2 primers.
2. Restriction enzymes and digestion
3. Reverse transcription-PCR analysis (e.g., BCR/ABL)
4. Use of molecular testing in minimal residual disease testing
5. DNA sequencing by Sanger sequencing for mutation detection: FLT3, NPM1, hemochromatosis mutation (C282Y and H63D), JAK2 mutation, etc.
6. Next-generation sequencing: gene panels, whole exome sequencing, and targeted sequencing
7. Role of molecular testing in bleeding and thrombotic disorders
8. Fusion gene quantification (BCR/ABL1, PML/RARA1)
9. Host-donor chimerism studies

14) Research activity:

Research is an important activity for all medical fields; however, for hematology, which is a fast-growing field, understanding the research process is important for each practitioner in the field. Residents are expected to gain exposure to research in both basic and clinical contexts. This can be achieved by attending courses on how to conduct research and

becoming involved in laboratory- and clinic-based research. Trainees are expected to engage in one research project and seek publication as the principle investigator, which includes writing a proposal, getting IRP approval, and executing the data collection, analysis, and composition of a full manuscript, including submission and publication, under the supervision of the program. Trainees are encouraged to participate in at least one other research project as the co-investigator and co-author of a publication.

IX. CONTINUUM OF LEARNING

This component includes the learning activities that should take place during each key stage of the program within the hematopathology department. Trainees will be reminded of the life-long need for continuous professional development (CPD). Trainees should keep in mind the role of CPD in helping healthcare providers meet the demands of their vital profession. The following table states how this component of the program is expected to progress throughout the junior, senior, and consultant levels of practice.

Undergraduate	R 1-2 (Junior Level)	R 3-4 (Senior Level)	Consultant
Non-practicing	Dependent/supervised practice	Dependent/supervised practice	Independent practice/provision of supervision
Obtain basic health science knowledge and foundational level of core disciplinary knowledge	Obtain fundamental knowledge of the normal morphology of hematopoietic cells and the basis of hemostasis/coagulation Develop an understanding of the basic scientific knowledge of pathophysiology and molecular biology of hematopoietic systems	Develop skills in the clinical interpretation of various hematological laboratory tests independently Apply knowledge and clinical judgment independently to reach a final opinion in lymphoma cases before discussing these cases with a signing consultant Demonstrate comprehensive knowledge of and practical experience in specialized tests and blood banking Apply the principles of quality management and laboratory administration	Function as independent specialists in the field of hematopathology who possess the vital skills needed to interpret submitted materials efficiently and accurately in a timely fashion Be competent in utilizing the diagnostic and ancillary studies required to convey appropriate opinions on challenging hematological disorders in a clear, concise, and scientific manner to the treating physician Manage a blood bank and practice safe transfusion medicine

X. TEACHING METHODS

1.1 Program-Specific Learning Activities:

1- Academic half day activity (weekly)

Every week, at least 2–4 hours of formal training time should be reserved for an academic half day for residents. The formal teaching schedule is planned with an assigned tutor, time slots, and venue. Trainee-selected topics are to be presented to the hematopathology scientific council for approval and should be selected in alignment with the hematopathology residency program's core competencies and teaching methods.

The academic half day will be conducted according to the following guidelines:

1. Trainees will be given the choice to develop a list of topics relevant to their needs.
2. All the topics must be pre-planned and not random.
3. All the topics must be approved by the hematopathology supervising committee.
4. Delivery will be local and take place within the program's context.
5. The supervising educator should ensure that the discussion of each topic is stratified into the three categories of the learning domain: knowledge, skills, and attitude.
6. The lectures will be conducted in an interactive, case-based discussion format.
7. The learning objectives of each core topic must be clearly defined, and it is preferable that pre-learning materials be used.

8. Whenever applicable, core specialty topics should include workshops, team-based learning (TBL), and simulations to develop trainees' skills in core procedures.

The half days will be conducted across 40 sessions of training per academic year. The remainder of the sessions will be reserved for other forms of teaching, such as journal clubs and clinical/practical teaching (see below). The lectures will be scheduled throughout two years and will be repeated every two years. A schedule for the current academic year with the venue and speaker should be provided at the beginning of every academic year. The residency training committee, program directors, and chief residents should work together to ensure the planning and implementation of academic activities as indicated in the curriculum in coordination with the academic and training affairs departments and regional supervisory committees.

An example of a hematopathology academic half day table is shown in Appendix F.

Other practice-based learning (PBL) and program-specific learning activities will be utilized to supplement academic half-day activities and may include the following:

1. Hematopathology case presentations outlining the following:
    - Presentations of the symptoms and clinical differential diagnoses
    - Laboratory data and imaging used and their indications and interpretation
    - Pathological findings, differential diagnoses, and final diagnoses
    - Ancillary studies, such as those on molecular diagnostics and flow cytometry
2. Thorough review of the laboratory safety manual and quality management manual
3. Resident review course (held during alternate years)

4. Journal clubs with the following goals:
    - Teaching critical appraisal
    - Staying abreast of the current medical literature
    - Providing a foundation for evidence-based practice
    - Reviewing landmark or controversial papers

Journal clubs will be presented by residents and actively supervised by the staff. Attendance is mandatory for residents. Journal club meetings will be held weekly and last for 60 minutes. Designated time will be provided and supported and endorsed by the program director and hematopathology section/departmental leaders. The activity is mainly directed by residents, who choose one to two relevant journal articles related to the specialty. A 20-30 minute presentation is followed by 10 minutes of critique for each paper and discussion with an emphasis on statistical analysis.

1. Multiple readings of hematopathology glass or virtual slide sessions
2. Participation in CBAHI and CAP inspections and inspections
3. CAP team member inspector online course CAP PT surveys
4. College of American Pathologists' external quality control slides (performance improvement program)
5. Royal College of Pathologists of Australia (RCPA) Quality Assurance Program
6. Hospital/departmental grand rounds and other continuous medical education activities
7. Multidisciplinary meetings and tumor boards

Optional activities:

Each institution must encourage trainees to complete the following educational activities:

1. The resident is encouraged to present at least once a year at a local, national, or international pathology meeting.
2. The resident is encouraged to review the department's teaching file.

3. The resident should be encouraged to attend national educational activities (symposia, workshops, review courses, etc.).

Practice-based learning:

1. In addition to doing routine daily work and evaluating cases, trainees/residents should attend daily case sign-outs with the consultant hematopathologists in service.
2. They are expected to record all the reviewed hematopathology cases in their respective portfolios. They must duly follow the rotation log sheet to cover the required tasks and objectives.
3. Residents are encouraged to participate in the department's educational activities.
4. After the first four months of the first year of residency, residents also participate in the on-call schedule (with faculty back-up).
5. Residents are encouraged to engage in self-study, including conducting regular reviews of the teaching slides, audiovisual materials, relevant scientific papers, etc. available in the department or provided by the faculty.
6. Residents are encouraged to attend national and international conferences.
7. Residents are encouraged to participate in the writing of a scientific manuscript or a paper of publishable quality in a peer-reviewed journal.
8. Residents are given opportunity to complete "coagulation rounds" with clinical colleagues, visit patients, and participate in patient interviews, if possible, to allow them to hone their skills in the workups and diagnosis of coagulation disorders.
9. Senior residents are encouraged to present clinically noteworthy cases at the multidisciplinary board meeting (bone marrow tumor and lymphoma tumor boards).

10. For improvement of career prospects during the program, residents are required to participate in elective rotations in two highly specialized areas of hematopathology within or outside the kingdom.
11. Each resident must examine and assess at least 3,000 hematological cases of an adequate level of diversity. This ensures exposure to both common and uncommon conditions and polishes the resident's critical diagnostic skills.
12. Each resident must perform at least five bone marrow aspirate/biopsy procedures during the senior years (R3-R4).
13. Each resident must participate in at least two research projects, one as the first author and the other as a co-author.
14. To maximize residents' training and education, they are encouraged to keep a portfolio throughout their training to enable them to check their progress in their professional training and ensure that they have met the year-to-year intended learning outcomes.

1.1 Universal Topics

Universal topics are educational activities that are developed by SCFHS and are intended for all specialties. Priority will be given to topics that reflect the following specifications:

- High value
- Interdisciplinary and integrated
- Require expertise that might be beyond the availability of the local clinical training sites

Universal topics have been developed by the SCFHS and are available via e-learning courses via personalized access for each trainee (to access the online modules). Each universal topic includes a self-assessment at the end of the module. As indicated in the "executive policies of continuous assessment and annual promotion," universal topics are a mandatory component of the criteria for the annual promotion of trainees from their current level of training to the subsequent one. Universal topics are distributed across the entire period of training. For more details, please refer to Appendix D.

XI. ASSESSMENT AND EVALUATION

1. Purpose of Assessment

The purposes of the assessments during the training are as follows:

- Supporting learning
- Developing professional growth
- Monitoring progression
- Judging competency and readiness for certification
- Evaluating the quality of the training program

A reliable and valid assessment is an excellent tool to assess the alignment of the curriculum with the objectives, learning methods, and assessment methods used.

The assessments are conducted toward the end of each training rotation in the form of formative assessments and at the end of academic year in the form of summative assessments.

There are two types of continuous assessment methods:

1. Formative continuous evaluation (FCE):

The end-of-rotation evaluation form must be completed within two weeks of the completion of rotation and signed by the program director. The program director discusses the results of the evaluation with the resident to provide constructive feedback for future improvement. (See Appendix E.)

2. Summative continuous evaluation (SCE):

This is a continuous periodic evaluation (given every four months) by supervisors to assess the resident's ongoing progress and competency at the assigned training center. At the end of the academic year, the average of these evaluations will be calculated and will represent 15% of the final exam score. (See Appendix F.)

2. Formative Assessment

Formative assessments (also referred to as continuous assessments) are a component of assessment that is distributed throughout the academic year with the primary aim of providing trainees with effective feedback.

2.1 General principles

1. Every two weeks, at least one hour should be designated for trainees to meet with their mentors to review performance reports.
2. Input from the overall formative assessment tools will be utilized at the end of the year to determine whether individual trainees will be promoted from the current to the subsequent training level.
3. Formative assessments will be defined based on the scientific (council/committee) recommendations (usually updated and announced for each individual program at the start of the academic year).
4. Judgments should be based on the holistic profiling of a trainee rather than individual traits or instruments.
5. Assessments should be continuous in nature.
6. The resident and faculty must meet to review the resident's performance for the purpose of providing feedback.
7. Assessments should be strongly aligned with the curriculum and intended learning outcomes.
8. Residents' evaluations and assessments throughout the program should be undertaken in accordance with the SCFHS's training and examination rules and regulations.

9. For promotion from one year to the next, residents are required to do the following:
    - Complete the allocated rotations satisfactorily each year.
    - Provide all logbooks for the attended rotations.
    - Pass the end-of-the-year evaluation that represents the average of the continuous evaluations given every four months.
    - Pass the end-of-the-year written (R1, R2, and R3) and oral (R1, R2, and R4) examinations.

2.2 Formative assessment tools

Learning domain	Formative assessment tools	Important details (e.g., frequency and specifications related to the tool)
Knowledge	1-Structured oral exam (SOE) 2- Annual promotion written exam 3- Final written exam 4-Structured academic activities	1- Three times (R1, R2, and R4) 2- For R1, R2, and R3 3- For the end of training 4- Provide proof of attendance in accordance with the SCFHS's policies and procedures
Skills	1- OSPE: Objective structured practical examination 2- Logbook 3- Research activities	1- For the final exam at end of training; consists of two parts: a- Computer-based images b- Long cases with an oral exam 2- Provide all logbooks before the one-month final exam 3- Each resident must provide proof of one first-author publication and one co-authored publication two weeks before the final exam
Attitude	ITER: in-training evaluation report	1- Interaction with clinicians and technologists and blood bank donors every four months/year

The evaluation of each component will be based on the following equation:

Percentage	< 50%	50-59.4%	60-69.4%	>70%
Description	Clear fail	Borderline fail	Borderline pass	Clear pass

To achieve unconditional promotion, the candidate must score a minimum of "borderline pass" in all four components.

The program director can still recommend the promotion of candidates if the above conditions are not met in some situations:

- In case the candidate scored "borderline failure" in one or two components at maximum, and these scores should not belong to the same area of assessment (for example: both borderline failures should not belong both to skills).
- The candidate must have passed all other components and scored a minimum of "clear pass" in at least two components.

3. Summative Assessment

3.1 General principles

Summative assessments are the component of assessment that primarily aims to help evaluators make informed decisions regarding trainees' competency. In contrast to formative assessments, *summative assessments* are not aimed at providing constructive feedback. For further details on this section, please refer to the general bylaws and executive policy of assessments (available online at www.scfhs.org). To be eligible to sit for the final exams, trainees are granted a "Certification of Training Completion" upon successful completion of all training rotations.

3.2 Promotion examination

This is a written and oral exam that permits the trainee to be promoted from the "junior" to the "senior" level of training after R1 and R2 and R3. For

further details on the promotion examination, please refer to the general bylaws and executive policy of assessment (available online at www.scfhs.org).

3.3 Final in-training evaluation report (FITER)

In addition to certification of completion of the clinical requirements (recorded in the resident's logbook) by the supervising committee, the FITER is also prepared by the program directors for each resident at the end of his/her final year of training. This report shall be the basis for obtaining the "Certification of Training Program Completion" and is a qualification needed to sit for the final specialty exams. The number of exam items, eligibility, and passing scores are determined in accordance with the commission's training and examination rules and regulations. The examination details, such as the date of the exam and an outline, are published on the commission's website: www.scfhs.org.sa.

Certification of Training Completion

To be eligible to sit for final specialty examinations, each trainee is required to obtain a "Certification of Training Completion." Based on the training bylaws and executive policy (please refer to www.scfhs.org), trainees are granted a "Certification of Training Completion" once the following criteria are fulfilled:

a) Successful completion of all the training rotations
b) Completion of the training requirements (e.g., keeping a logbook, conducting research, others) as outlined in the FITER approved by the Scientific Council/Committee of the specialty
c) Clearance from SCFHS training affairs department, which ensures payment of tuition and the completion of the universal topics
d) Having passed all the promotion exams (both written and oral)

A "Certification of Training Completion" will be issued and approved by the supervisory committee or its equivalent according to the SCFHS's policies.

3.4 Final specialty examinations

The final Saudi Board Examination is composed of three parts:

1. Written examination:

This examination assesses candidates' theoretical knowledge base (including knowledge of recent advances) and problem-solving capabilities in the specialty of hematopathology. It is delivered in an MCQ format. A resident can sit for the written exam if he/she has passed the FITER; if the written portion is passed, he/she can then sit for the practical section. This component represents 40% of the final grade.

2. Practical examination (OSPE):

This examination assesses a broad range of high-level clinical and diagnostic skills. The examination is delivered in the format of an objective structured clinical/practical examination (OSPE). The practical exam is computer-based and includes images and short clinical cases of various hematological disorders to test the resident's ability to identify morphological changes in various hematological disorders and establish a diagnosis. The other part includes long cases with some slides using light microscopy to identify morphology and assess the resident's skill in recognizing various morphological features to establish a diagnosis for malignant and benign hematology disorders. This part represents 45% of the final grade.

3. Oral examination:

The oral exam is conducted in the form of a case-based discussion (CBD) on a yearly basis for promotion except at the end of training, when it is replaced by the final exam and it represents 15% of the final grade.

1-An outline of the written exam is shown in the following table:

Contents						
Categories	Sections	Proportions	Medical science	Diagnosis	Management	Investigations
Nonmalignant hematopathology 40%	Anemias	15%	4	4	1	4
	Hemostasis and platelets	15%	4	4	1	4
	Bone marrow failure disorders	5%	2	1	1	1
	Immunologic abnormalities and leukocyte disorders	5%	0	1	1	1
Malignant hematopathology 30%	Leukemias, MPN, and MDS	20%	3	3	1	4
	Histiocytic disorders and lymphomas	10%	4	4	1	4
Transfusion medicine 20%	Blood banking, transfusion apheresis, and stem cell transplantation	20%	1	1	2	1
Lab quality and management 10%	Data analysis, professionalism, and patient safety	10%	5	0	5	0
	Total	100%				

An outline of the practical exams (OSPE) is shown in the following table:

NO	Categories	Sections	Number of stations	Type of station
1	Nonmalignant hematopathology 40%	Anemias	1	microscopic
		Hemoglobin disorders	1	dry
		Hemostasis and platelets	1	dry
		Bone marrow failure disorders	1	dry
		Leukocyte disorders	1	microscopic
2	Malignant hematopathology 30%	Leukemias	1	microscopy
		MPN and MDS	1	microscopy
		Histiocytic disorders and lymphomas	1	microscopy
3	Blood banking and transfusion medicine 20%	Blood banking and donor issues	1	dry
		Transfusion	1	dry
		Apheresis and stem cell transplantation	1	dry
4	Lab quality and management 10%	Data analysis, professionalism, and patient safety	1	dry
5	Communication skills	Interactions with clinical colleagues, patients receiving transfusions, and blood donors	1	practice
		Total	13	

An outline of the practical exams (computer-based morphology exams) is shown in the following table:

NO	Categories	Sections	Number of microscopic images
1	Nonmalignant hematopathology 40%	Anemias	2
		Hemoglobin disorders	2
		Hemostasis and platelets	1
		Bone marrow failure disorders	1
		Leukocyte disorders	1
2	Malignant hematopathology 60%	Leukemias	5
		MPN and MDS	5
		Histiocytic disorders and lymphomas/myelomas	3
		Total	20

Learning Domain	Summative Assessment Tools	Passing Score
Knowledge	- Final Written Examination	Achieve at least a borderline passing score for each tool in accordance with the standard-setting method used by the executive administration of assessments
Skills	- Objective Structured Clinical Examinations (OSCEs) - Structured Oral Examinations (SOEs)	Achieve at least a borderline passing score for each tool in accordance with the standard-setting method used by the executive administration of assessments
Attitude	FITER: In-Training Evaluation Report	Successfully pass the FITER

XII. PROGRAM AND COURSE EVALUATIONS

The SCFHS applies variable measures to evaluate the implementation of this curriculum. The training outcomes of this program must comply with the quality assurance framework endorsed by the Central Training Committee at the SCFHS. Trainees' assessment results (both formative and summative) are analyzed and mapped to ensure compliance with the curriculum's content. Some other indicators include the following:

- Reports of the annual trainee satisfaction survey
- Reports of the trainees' evaluations of the faculty members
- Reports of the trainees' evaluations of the rotations
- Reports from the annual survey of the program's directors
- The data available from program accreditations
- Reports from direct field communications with trainees and trainers

The use of goal-based evaluation means that the intended milestone achievements are evaluated at the end of each stage to assess the progress of curriculum delivery, and any deficiencies are addressed in the following stage utilizing the time devoted for trainee-selected topics and professional sessions.

In addition to providing subject-matter opinions and reflecting the best practices from benchmarked international programs, the SCFHS applies a robust method to ensure that evaluators utilize all the data available when this curriculum is revised in the future.

XIII. POLICIES AND PROCEDURES

This curriculum outlines the learning objectives that trainees and trainers must strive to meet for the purpose of achieving the identified educational outcomes, and it describes the necessary means and materials. The Saudi Commission for Health Specialties (SCFHS) has a full set of "General Bylaws" and "Executive Policies" (published on the official SCFHS website) that regulate all training-related processes. The general bylaws of training, assessment, and accreditation and the executive policies on admissions, registration, continuous assessments and promotion, examinations, trainee representation and support, duty hours, and leave policies are examples of regulations that must be implemented. Under this curriculum, trainees, trainers, and supervisors must comply with the most updated bylaws and policies, which can be accessed online via the official SCFHS website.

XIV. APPENDICES

A. Glossary
B. Mapping of learning objectives and competency roles to program rotations
C. Examples of academic half-day tables
D. Universal topic modules
E. Rotation evaluation
F. Resident summative continuous evaluation (SCE)
G. Competency logbook for various rotations
    1. General laboratory - practical logbook
    2. General hematology - practical logbook
    3. Special hematology - practical logbook
    4. Special coagulation - practical logbook
    5. Special hemoglobinopathy - practical logbook
    6. Flow cytometry - practical logbook
    7. Cytogenetics - practical logbook
    8. Molecular genetics - practical logbook
    9. Blood banking and transfusion medicine – practical logbook
    10. Laboratory quality assurance and laboratory management – practical logbook
    11. Laboratory safety program form
H. Log sheet for performed laboratory tests and attended clinical cases
I. Portfolio log sheet
    1- Peripheral blood smears and bodily fluid morphology rotation
    2- Bone marrow rotation
    3- Lymph node pathology rotation

4- Molecular, cytogenetics, and flow cytometry diagnosis rotation

5- Coagulation and hemoglobinopathy rotation

6- Transfusion medicine and clinical rotation

J. References

A Glossary

Glossary	
Outline	A description correlating educational objectives with assessment contents. For example, the test outline defines the proportion of test questions allocated to each learning domain and/or content area.
Competency	Ability to function within a defined professional role that implies the credibility of a trainee due to graduation from the program with the required knowledge, skills, and attitudes needed to practice in the field unsupervised.
Specialty core content (skills, knowledge, and professional attitudes)	A specific area of knowledge or skill or professional attitude that is specific and integral to a given specialty.
Formative assessment	An assessment that is used to inform the trainer and learner of what has been taught and learned, respectively, for the purpose of improving learning outcomes. Typically, the results of formative assessments are communicated through feedback given to the learner. Formative assessments are not primarily intended to aid in making judgments or decisions (although this can be viewed as a secondary goal).
Mastery	Status indicating that a trainee has exceeded the minimum level of competency necessary to claim a proficient level of performance, indicating that he/she possesses rich experience and great knowledge, skills, and attitudes.

Portfolio	A collection of evidence of progression toward competency. It may include both constructed components (defined by the mandatory continuous assessment tools in the curriculum) and unconstructed components (selected by the learner).
Summative assessment	An assessment that describes the composite performance of the development of a learner at a specific point in time, which is used to inform judgments and aid in making decisions about a trainee's level of learning and certification.
Universal topic	An area of knowledge, skills, or professional behavior that is not specific to the given specialty but is universally applicable to the general practice of a given healthcare profession.

B Mapping of learning objectives and competency roles to program rotations

Training Year level	Professional Activities Related to Specialties					
	Competency Roles (with annotations of the learning domains involved: K: knowledge, S: skills, A: attitudes)	Possess knowledge of how to perform the necessary duties and the ability to interpret the data obtained from blood samples, smears, bone marrow biopsies, hemoglobin/protein electrophoresis, and general coagulation assays K, S	Learn about quality management with the aim of running a lab in the future K, S, A	Learn the basic blood banking principles of transfusion medicine, apheresis, and clinical applications K, S	Understand how to ensure high quality in testing and the management of a laboratory K, S	Learn about integrating morphology and other laboratory tests K, S
R1	**Professional Expert**	Demonstrate understanding of the principles of routine coagulation	Practice quality control measures during testing and	Develop the ability to resolve routine blood bank-related	Understand how to release laboratory results to clinical	Understand and practice the reporting of various laboratory tests S, K, A

Training Year level	Professional Activities Related to Specialties					
		assays, flow cytometry, and cytogenetic and molecular studies K, S	interpretation of results S, A	issues K, S	colleagues during MDT meetings and individually A, S	
	Communicator	Effectively communicate with lab technologists and clinical colleagues S, A	Effectively communicate with blood donors K, S, A	Effectively communicate with patients and team members K, S, A	Possess writing, dictation, and presentation skills K, S	Under the supervision of the attending pathologist, possess the ability to observe and actively interact with radiologists, physicians, and surgeons to obtain further history orinformation regarding a specimen
	Collaborator	Conduct multidisciplinary studies and engage in team work S, A	Conduct multidisciplinary studies and engage in team work S, A	Engage in interprofessional communication A	Engage in interprofessional communication A	Engage in interprofessional communication A

Training Year level	Professional Activities Related to Specialties					
	Advocate	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A
R2	**Professional Expert**	Possess knowledge of how to perform the related duties and the ability to interpret the data obtained from blood samples, smears, bone marrow biopsies, hemoglobin/protein electrophoresis, and general coagulation assays K, S	Learn about quality management with the aim of running a lab in the future K, S, A	Learn the basic blood banking principles of transfusion medicine, apheresis, and clinical applications K, S	Understand how to practice high quality testing and management of a laboratory K, S	Learn about integrating morphology and other laboratory tests K, S
		Demonstrate understanding of the	Practice quality assurance	Develop the ability to resolve	Understand how to release	Understand and practice the reporting of

Training Year level	Professional Activities Related to Specialties					
		principles of routine coagulation assays, flow cytometry, and cytogenetic and molecular studies K, S	measures during testing and interpretation of results S, A	routine blood bank-related issues K, S	laboratory results to clinical colleagues during MDT meetings and individually A, S	various laboratory tests S, K, A
	Communicator	Effectively communicate with lab technologists and clinical colleagues S, A	Effectively communicate with blood donors K, S, A	Effectively communicate with patients and team members K, S, A	Possess writing, dictation, and presentation skills K, S	Under the supervision of the attending pathologist, possess the ability to observe and actively interact with radiologists, physicians, and surgeons to obtain further history or information regarding a specimen
	Collaborator	Conduct multidisciplinary studies and engage in team work	Conduct multidisciplinary studies and engage in team work	Engage in interprofessional communication	Engage in interprofessional communication	Engage in interprofessional communication A

Training Year level	Professional Activities Related to Specialties					
		S, A	S, A	A	A	
	Advocate	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A	Adopt a holistic approach and employ preventive medicine K, S, A
	Professional	Acknowledge limitations and the need to seek help to ensure patient safety K, A	Develop sense of how to appropriately prioritize tasks K, S, A	Develop sense of how to appropriately prioritize tasks K, S, A	Develop sense of how to appropriately prioritize tasks K, S, A	Develop sense of how to appropriately prioritize tasks K, S, A

Senior-Level Competency Matrix: Map of Competencies, Learning Domains, and Milestones

Training Year level	Professional Activities Related to Specialties					
R3	**Competency Roles (with annotations of the learning domains involved: K: knowledge, S: skills, A: attitudes)**	Possess knowledge of how to perform the related duties and the ability to interpret the data obtained from blood samples, smears, bone marrow biopsies hemoglobin/protein electrophoresis, and general coagulation assays K, S	Learn about quality management with the aim of running a lab in the future K, S, A	Learn the basic blood banking principles of transfusion medicine, apheresis, and clinical applications K, S	Understand how to practice high quality testing and management of a laboratory K, S	Learn about integrating morphology and other laboratory tests K, S
	Professional Expert	Understand the entire process of bone marrow examination. Understand the principles of hematopoiesis. Interpret bone marrow findings within the	Apply the basic principles of immuno-blood banking, donor testing, and blood components/	Understand the principles of advanced coagulation and platelet tests with the aim of making the best diagnosis of	Understand how to effectively use the results of cytogenetic, flow cytometric, and molecular	Understand how to effectively use the results of cytogenetic, flow cytometric, and molecular

Training Year level	Professional Activities Related to Specialties					
		framework of most recent WHO classification K, S, A	products with their clinical indications K, S	the related disorders and providing consultative services for various related topics K, S, A	studies in interpreting morphologic and clinical findings K, S	studies in interpreting morphologic and clinical findings K, S
	Communicator	Liaise effectively with clinical and other diagnostic service professionals. Expertly deliver information to clinicians and other health professionals K, S, A	Understand how to review clinical notes in a way that is relevant to the interpretation of hematologic investigations K, S, A	Understand how to review clinical notes in a way that is relevant to the interpretation of hematologic investigations K, S, A	Understand how to review clinical notes in a way that is relevant to the interpretation of hematologic investigations K, S, A	Understand how to review clinical notes in a way that is relevant to the interpretation of hematologic investigations K, S, A
	Collaborator	Contribute effectively to interdisciplinary teams K, S, A	Identify one's role in the healthcare environment K, S	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A

Training Year level	Professional Activities Related to Specialties					
	Advocate	Participate in community- and academia-based health promotion and education activities S, A	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Understand how to pick up on subtle and atypical findings S, A	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Understand how to pick up on subtle and atypical findings	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Understand how to pick up on subtle and atypical findings	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Understand how to pick up on subtle and atypical findings
	Leader	Begin to recognize the role of a pathologist as a medical director S, A	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity
	Scholar	Possess the ability to apply an evidence-	Teach junior colleagues. Develop and	Develop the ability to critically	Develop the ability to critically	Develop the ability to critically

Training Year level	Professional Activities Related to Specialties					
		based approach to answering questions related to diagnostic hematology K, S, A	maintain a personal continuing education strategy K, S, A	appraise literature K, S, A	appraise literature K, S, A	appraise literature K, S, A
	Professional	Demonstrate appropriate professional behavior in practice and understanding of the related legal and ethical codes K, S, A	Demonstrate respect for patient confidentiality and strategies for disclosing adverse events to patients S, A	Demonstrate ethical behavior	Demonstrate ethical behavior	Demonstrate ethical behavior
R4		Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings within the framework of the most recent WHO classification K, S, A	Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings within the framework of the most recent WHO	Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings within the framework of the most recent WHO	Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings	Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings within the framework of the most recent WHO

Training Year level	Professional Activities Related to Specialties					
			classification K, S, A	classification K, S, A	within the framework of the most recent WHO classificatio n K, S, A	classification K, S, A
	Professional Expert	Understand the entire process of bone marrow examination. Know the principles of hematopoiesis. Interpret bone marrow findings within the framework of the most recent WHO classification K, S, A	Apply the basic principles of immuno-blood banking, donor testing, and blood components/ products with their clinical indications K, S	Understand the principles of advanced coagulation and platelet tests with the aim of making a diagnosis of related disorders and providing consultative services for various related topics K, S, A	Effectively use the results of cytogenetic, flow cytometric, and molecular studies in interpreting morphologi c and clinical findings K, S	Effectively use the results of cytogenetic, flow cytometric, and molecular studies in interpreting morphologic and clinical findings K, S
	Communicato r	Liaise effectively with clinical and other diagnostic services. Expertly deliver information to clinicians and other health	Possess the ability to review clinical notes in a way that is relevant to the interpretatio	Possess the ability to review clinical notes in a way that is relevant to the interpretatio	Possess the ability to review clinical notes in a way that is relevant to the	Possess the ability to review clinical notes in a way that is relevant to the interpretatio

Training Year level	Professional Activities Related to Specialties					
		professionals K, S, A	n of hematologic investigations K, S, A	n of hematologic investigations K, S, A	interpretation of hematologic investigations K, S, A	n of hematologic investigations K, S, A
	Collaborator	Contribute effectively to an interdisciplinary team K, S, A	Identify one's role in the healthcare environment K, S	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A	Develop the ability to resolve any misunderstandings and conflicts that may arise K, S, A
	Advocate	Participate in community- and academia-based health promotion and education activities S, A	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Possess the ability to pick up on subtle and atypical findings	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Possess the ability to pick up on subtle and atypical findings	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Possess the ability to pick up on subtle and atypical	Understand the importance of IHC controls in every run. Confidently interpret ancillary test results in a clinical context. Possess the ability to pick up on subtle and atypical findings

Training Year level	Professional Activities Related to Specialties					
			S A	S, A	findings S, A	S, A
	Leader	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity S, A	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity S, A	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity S, A	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity S, A	Perform root-cause analysis for ambiguous and uncertain results and suggest methods to overcome ambiguity S, A
	Scholar	Possess the ability to apply an evidence-based approach to answering questions related to diagnostic hematology K, S, A	Teach junior colleagues. Develop and maintain a personal continuing education strategy K, S, A	Develop the ability to critically appraise literature K, S, A	Develop the ability to critically appraise literature K, S, A	Develop the ability to critically appraise literature K, S, A
	Professional	Demonstrate appropriate professional behavior in practice and understanding of the relevant legal and ethical codes	Demonstrate respect for patient confidentiality and employ strategies to disclose adverse	Demonstrate ethical behavior S, A	Demonstrate ethical behavior S, A	Demonstrate ethical behavior S, A

Training Year level	Professional Activities Related to Specialties					
		S, A	events to patients S, A			

C Examples of academic half day tables

The following is a table with sample topics that illustrate the half day activities spanning the course of a typical year:

Academic week	Section	Date	Time	Sessions	Presenters
1	INTRODUCTION TO HEMATOPATHOLOGY AND TRANSFUSION MEDICINE	Oct-5	13:00-14:00	Normal cytology, histology and anatomy of bone marrow, lymph nodes, spleen, and thymus	A
			14:00-15:00	Hematology laboratory structure and specimen processing	B
			15:00-16:00	General concepts of transfusion medicine and blood grouping	C
2	INTRODUCTION TO LABORATORY MANAGEMENT AND QUALITY CONTROL	Oct-12	13:00-14:00	Quality control, quality assurance, and lab safety	D
			14:00-15:00	Case-based study	D
			15:00-16:00	Laboratory informatics (LIS)	E
3	PHYSIOLOGIC, MOLECULAR, AND MORPHOLOGIC	Oct- 19	13:00-14:00	Ontogeny and development of blood cells	F
			14:00-15:00	Case-based study	G

Academic week	Section	Date	Time	Sessions	Presenters
	BASIS OF HEMATOPOIESIS IN HEALTH AND DISEASE		15:00-16:00	Phenotypic and molecular markers in hematopoietic cells	H
4	GENERAL HEMATOLOGY	Oct- 26	13:00-14:00	Journal club (topic related to automation)	I
			14:00-15:00	Case-based study	J
			15:00-16:00	Laboratory automation in hematology	K

D Universal topics

Training Year	Modules		Topic names	
	Number	Name	Number	Name
R1	Module 1	Introduction	Topic 1	Introduction to laboratory medicine
	Module 1	Introduction	Topic 5	Blood transfusion
	Module 2	Morphology	Topic 6	How to use light microscopy for morphology
	Module 2	Cancer	Topic 9	Cancer prevention
	Module 3	Diabetes and metabolic disorders	Topic 13	Comorbidities of obesity
R2	Module 1	Introduction	Topic 2	Hospital-acquired infections
	Module 1	Introduction	Topic 3	Sepsis, SIRS, and DIVC
	Module 2	Cancer	Topic 7	Side effects of chemo/radiation
	Module 2	Cancer	Topic 8	Oncologic emergencies
	Module 3	Diabetes and metabolic	Topic 11	Recognition and management

Training Year	Modules		Topic names	
	Number	Name	Number	Name
		disorders		of diabetic emergencies
R3	Module 1	Introduction	Topic 4	Antibiotic stewardship
	Module 2	Cancer	Topic 10	Surveillance and follow-up of cancer patients
	Module 4	Medical and surgical emergencies	Topic 15	Management of acute chest pain
	Module 4	Medical and surgical emergencies	Topic 16	Management of acute breathlessness
	Module 2	Medical and surgical emergencies	Topic 17	Management of hypotension and hypertension
R4	Module 3	Diabetes and metabolic disorders	Topic 12	Management of diabetic complications
	Module 4	Medical and surgical emergencies	Topic 18	Management of upper GI bleeding
	Module 4	Medical and surgical emergencies	Topic 19	Management of lower GI bleeding
	Module 6	Frail/elderly patient issues	Topic 23	Prescribing drugs for the elderly
	Module 7	Ethics and healthcare	Topic 26	Occupational hazards of HCW

E Rotation Evaluation

Resident Name:				Level:	
Staff Supervisor:					
Name of Rotation:	Duration		Date	Institution	

Points of evaluation	Unsatisfactory	Below average	Average	Above average	Outstanding	NA
	1	2	3	4	5	
Attendance and punctuality						
Specimen handling						
Level of knowledge of test indications						
Level of knowledge of quality control						
Level of knowledge of the procedure principles						
Level of knowledge of the procedure/assay steps						
Recognition and acknowledgement of the standard operating procedures (SOPs)						
Level of knowledge of troubleshooting						
Effectiveness of communication with patients, colleagues, and other health professionals						
Level of competency						
Hands-on participation						
Teamwork						
Level of interest						
Level of knowledge of laboratory safety						

Comments	
Resident signature	
Supervisor signature	
Pathologist signature	

F Resident summative continuous evaluation (SCE):

Resident Name:				Level:	
Staff Supervisor:					
Evaluation Date:	First	Second	Third	Institution	

Scale to evaluate the presentation	Unsatisfactory	Below average	Average	Above average	Outstanding	Remarks
	1	2	3	4	5	
Scientific approach to practice						
Integration of basic and clinical sciences into medical practice						
Delivery of evidence-based health care						
Presentation at an appropriate level and with adequate details						
Patient care						
Demonstration of essential clinical skills						
Demonstration of clinical-reasoning, decision-making, and problem-solving skills						
Recognition of life-threatening medical conditions						

Scale to evaluate the presentation	Unsatisfactory	Below average	Average	Above average	Outstanding	Remarks
	1	2	3	4	5	
Recognition of common medical problems						
Willingness to place patients' needs and safety at the center of the care process						
Community-oriented practice						
Understanding of the healthcare system in Saudi Arabia						
Advocacy for health promotion and disease prevention						
Communication and collaboration						
Effective communication with patients, colleagues, and other health professionals						
Teamwork and inter-professional collaboration						
Application of medical informatics in the healthcare system						
Professionalism						
Punctuality						
Adherence to professional attitudes and behaviors of physicians						
Application of Islamic, legal, and ethical principles of professional practice						
Commitment to personal and professional development						
scholarship						

Scale to evaluate the presentation	Unsatisfactory	Below average	Average	Above average	Outstanding	Remarks
	1	2	3	4	5	
Demonstration of basic research skills						
Demonstration of scholarly pursuits						
Active participation in research and scholarly activities						
Marks						
Comments						
Resident signature						
Pathologist signature						

G-1 General laboratory - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Blood collection with various tubes (adults and pediatrics)		
Specimen collection, storage, and transportation		
Specimen processing		
Core lab components		
Biochemistry instrumentation		
Urinalysis		
Special chemistry overview		
Quality measures for core laboratory skills		
Microbiology general tests		
Microbiology special tests and cultures		
Mycology		
Virology		

Signed by supervisor: _____

Section: _____

G-2 General hematology - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
CBC automation		
Preparation of Wright-Giemsa stain		
Blood film preparation and staining		
Differential count on PBS		
ESR		
Thick blood film for Malaria		
Reticulocyte count manual/automated		
PT		
aPTT		
Mixing study		
TT		
PFA		

Signed by supervisor : _____

Section: _____

G-3 Special hematology - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Heinz body preparation slide		
Heat instability test		
Screening test for G-6-PD and PK deficiency		
Osmotic fragility		
Solubility test		
BM aspirate staining		
Peripheral blood smear morphology		
Malaria thick and thin smears		
Cerebrospinal fluid cytospin		
Pleural, pericardial, and peritoneal fluids		
Synovial fluid		
Bronchoalveolar lavage		
Hemoglobin H, Heinz body		

Signed by supervisor : _____

Section: _____

G-4 Special coagulation - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Platelet aggregation and adhesion studies		
Coagulation factor assays (FII-FXIII)		
Coagulation inhibitor tests		
Lupus anticoagulant (LA)		
Natural anticoagulants (PC, PS, ATIII)		
Activated protein C resistance		
Heparin-induced thrombocytopenia test (HIT)		
Platelet aggregation		
Anti-factor Xa for heparin		
Anti-factor Xa for LMWH		
Anti-factor Xa for DOACs		
Von Willebrand factor activity and function		

Signed by supervisor : _____

Section: _____

G-5 Special hemoglobinopathy - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Gel hemoglobin electrophoresis		
Automated hemoglobin electrophoresis		
Hb-F measurement		
Hb-A2 measurement		
Performance of Sickling test		
Hemoglobin electrophoresis reporting		
Performance of protein electrophoresis		
Performance of immunofixation		
Interpretation of protein electrophoresis results		
Gel hemoglobin electrophoresis		
Automated hemoglobin electrophoresis		
Hb-H preparation		
Quality management		

Signed by: _____

Section: _____

G-6 Flow cytometry - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Instrumentation		
· Introduction, lasers, flurochromes, and filters		
· Basic elements of flow cytometry, including operation principles		
· Compensation		
CD classification		
Panel design		
Unit establishment		
Data analysis		
· CD45 and light scatter		
· Gating strategy		
· Benign vs. malignant populations		
· Leukemia		
· Lymphoma		
· Multiple myloma		
· DNA Analysis		
· CD34 enumeration		
. Analysisof MRD		
Quality management		

Signed by: _____

Section: _____

G-7 Cytogenetics - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Specimen collection, storage, and processing (pre/post-natal blood and hematological specimens)		
Cytogenetis		
Cell culture		
Harvesting		
Slide preparation and staining		
ASI		
FISH		
Cell culture		
Harvesting		
Slide preparation and staining		
Slide treatment (types of probes)		
Clinical interpretation		
Define the term karyotype.		
Identify the six chromosome groups (A-G).		
Distinguish between constitutional and acquired karyotypes.		
Define and describe a clinical example of the following chromosome abnormalities.		
Outline the application of FISH testing.		
Conduct FISH interpretation under a microscope.		
Outline various probing methods for various hematological		

OBJECTIVES	Competency achieved (Y/N)	Remarks
diseases.		
Quality management		

Signed by: _____

Section: _____

G-8 Molecular genetics - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
DNA/RNA Extraction		
PCR for IgH and TCR (BIOMED-2)		
RT-PCR for BCR/ABL1; PML/RARA1		
Donor chimerism studies		
NGS myeloid panel		
AML, mutations		
Other single-gene mutations (p53, IgVH, BRAF)		
MPN mutations/sequencing		
Thrombophilia mutations		
Thalassemia/hemoglobinopathy studies		
Quality management		

Signed by: _____

Section: _____

G-9 Blood banking and transfusion medicine - practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
Perform manual blood grouping - tube method		
Perform manual blood grouping - gel method		
Perform antibody screening - tube method		
Perform antibody screening - gel method		
Perform a direct antiglobulin test (DAT)		
Perform a donor assessment		
Observe donor phlebotomy		
Observe component preparation		
Observe donor testing		
Observe pathogen reduction		
Observe blood irradiation		
Perform manual blood grouping - tube method		
Perform cross-matching - gel method		
Perform antibody titration		
Perform antibody elution		
Perform a donor assessment		
Perform a donor phlebotomy		
Perform donor counseling		

OBJECTIVES	Competency achieved (Y/N)	Remarks
Observe automated blood donation/peripheral stem cell collection		
Complete a transfusion reaction investigation		
Perform a therapeutic apheresis assessment		
Attend a Blood Utilization Review Committee meeting		
Attend a blood bank quality management meeting		

Signed by: _____

Section: _____

G-10 Laboratory quality assurance and laboratory management – practical logbook

Trainee Name: _____

OBJECTIVES	Competency achieved (Y/N)	Remarks
New analyzer/test validation plan		
Laboratory improvement project		
Performance of risk assessment		
Attendance at laboratory administrative meeting		
Completion of an occurrence variance investigation		
Performance of a monthly QC review		
Review of the CAP checklist		
Attendance at an inspection for laboratory accreditation		
Review of the SEPAHI check list		

Signed by: _____

Section: _____

G-11 Laboratory safety program form

Trainee Name: _____

This form is designed to confirm that trainees understand and can apply laboratory safety instructions.

OBJECTIVES	Competency achieved (Y/N)	Remarks
I have participated in a laboratory safety induction program or educational session		
I have reviewed the laboratory safety manual.		
I know where to find the laboratory safety equipment and how to use it.		
I have known immunity to hepatitis B (natural or vaccine).		
I have been vaccinated and/or screened for other infectious diseases as required by my laboratory. I know how and when to wash my hands and carry this procedure out.		
I wear closed shoes in the laboratory and tie back my long hair if applicable		
I wear appropriate protective clothing (gown, gloves, goggles, and mask as needed) and always remove it before leaving the laboratory.		
I cover any cuts or wounds before working in the laboratory.		
I never eat or put anything in my mouth while in the laboratory.		
I know how to handle blood and other bodily substances		

OBJECTIVES	Competency achieved (Y/N)	Remarks
and tissues to avoid transmission of infection to myself and others.		
I know how to prevent sharps injuries.		
I am aware of electrical, chemical, radiation, and biological hazards and how to prevent them. I know what to do in an emergency.		
I know the procedure for reporting safety-related incidents.		
I know where to find information about the legislative requirements for laboratory safety.		
I know where to find detailed information about laboratory hazards, such as dangerous chemicals.		
I always clean up after myself. I set up my workspace and ensure correct posture and lifting techniques to avoid strain and injuries.		

Signed by: _____

Section: _____

H-Log sheet for required Laboratory tests and attended clinical cases

Trainee Name: _____

OBJECTIVES	Minimum cases#	performed cases during all rotations #
Blood film morphology and bodily fluids	1000	
Bone marrow morphology	500	
Acute myeloid leukemia	100	
Acute lymphoblastic leukemia with abnormalities	150	
Myelodysplastic syndrome	20	
Myeloproliferative neoplasm	100	
Multiple myeloma	50	
Lymphoma with BM involvement	10	
Lymphoproliferative disorders	30	
BM failure syndromes	30	
Other non-malignant bone marrow exams	10	
Lymphoma cases	50	
Hemoglobin electrophoresis	400	
Coagulation	400	
Bleeding for investigation	100	
Thrombosis for investigation	100	
Platelet disorders	30	
Hemophilia with an inhibitor	30	

OBJECTIVES	Minimum cases#	performed cases during all rotations #
vWD various types	60	
HIT	30	
Monitoring of anticoagulation	50	
Serum protein electrophoresis	50	
Flow cytometry	400	
Molecular genetics and cytogenetics	200	
Therapeutic plasma apheresis	20	
Platelets and other cellular collections	20	
Attendance at a general hematology clinic	4	
Attendance at a leukemia clinic	2	
Attendance at a lymphoma clinic	2	
Attendance at a thrombosis clinic	4	
Attendance at a bleeding clinic	4	
Attendance at a BMT clinic	2	
Performance of bone marrow aspirate/biopsy procedures	10	
Publication of research	2	

Note : resident has to register all acquired skills and performed procedures with patient medical records for presentation if asked the program directors

I-1 PERIPHERAL BLOOD SMEAR AND BODILY FLUID MORPHOLOGY ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology /Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

S. No.	Date	Pathology /Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

Instructions:

1. Document only cases in which the resident trainee has personally attended and reported the microscopic assessment with the signing consultant.
2. The resident trainee is required to complete at least 500 cases involving peripheral blood smears and bodily fluid morphology during four years of training.
3. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his/her level of training.
4. This log sheet must be reviewed and signed off on by the program director at the end of the rotation.
5. Use a new form at the start of each year of training.
6. Print additional copies if necessary.

I-2 BONE MARROW ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology No.	Specimen Type	Diagnosis	Consultant	Remarks

S. No.	Date	Pathology No.	Specimen Type	Diagnosis	Consultant	Remarks

Instructions:

1. Document only cases in which the resident trainee has personally attended and reported the microscopic assessment with the signing consultant.
2. The resident trainee is required to complete at least 500 cases involving bone marrow examination during four years of training.
3. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his/her level of training.
4. This log sheet must be reviewed and signed off on by the program director at the end of the rotation.
5. Use a new form at the start of each year of training.
6. Print additional copies if necessary.

I-3 LYMPH NODE PATHOLOGY ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology No.	Specimen Type/Complexity*	Diagnosis	Consultant	Remarks

S. No.	Date	Pathology No.	Specimen Type/Complexity*	Diagnosis	Consultant	Remarks

Instructions:

1. Document only cases in which the resident trainee has personally attended and reported the microscopic assessment with the signing consultant.
2. The resident trainee is required to complete at least 100 cases involving lymph node pathology examinations during four years of training.
3. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his/her level of training.

4. This log sheet must be reviewed and signed off on by the program director at the end of the rotation.
5. Use a new form at the start of each year of training.
6. Print additional copies if necessary.

*Lymph node, biopsy, all sites = 4; Lymph node, biopsy, for lymphoma or lymphoproliferative disorder = 5; Lymph nodes, regional resection, all sites = 5.

(RCPA Handbook, 2021)

I-4 MOLECULAR, CYTOGENETICS, AND FLOW CYTOMTRY DIAGNOSIS ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology/Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

S. No.	Date	Pathology/Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

Instructions:

1. Document only cases in which the resident trainee has personally attended and observed or interpreted samples with the signing consultant.
2. The resident trainee is required to complete at least 200 cases involving molecular diagnosis examinations during four years of training.
3. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his/her level of training.
4. This log sheet must be reviewed and signed off on by the program director at the end of the rotation.
5. Use a new form at the start of each year of training.

6. Print additional copies if necessary.

I-5 COAGULATION AND HEMOGLOBINOPATHY ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology/Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

S. No.	Date	Pathology/Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

Instructions:

7. Document only cases in which the resident trainee has personally attended and observed or interpreted samples with the signing consultant.
8. The resident trainee is required to complete at least 200 cases involving molecular diagnosis examinations during four years of training.
9. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his level of training.
10. This log sheet will be reviewed and signed off by the program director at the end of the rotation.
11. Use new form at the start of each year of training.
12. Print additional copies if necessary.

I-6 TRANSFUSION MEDICINE AND CLINICAL ROTATION

RESIDENT NAME:

LEVEL OF TRAINING (YEAR):

NAME OF TRAINING INSTITUTE:

PERIOD OF ROTATION:

S. No.	Date	Pathology/ Lab No.	Specimen Type	Diagnosis	Consultant	Remarks

Instructions:

13. Document only cases in which the resident trainee has personally attended and observed or interpreted samples with the signing consultant.
14. The resident trainee is required to complete at least 200 cases involving molecular diagnosis examinations during four years of training.
15. The supervising consultant is required to certify that the trainee has adequately dealt with the case according to his/her level of training.
16. This log sheet must be reviewed and signed off on by the program director at the end of the rotation.
17. Use a new form at the start of each year of training.
18. Print additional copies if necessary.

J REFERENCES

1- Memish ZA, Owaidah TM, Saeedi MY. Marked regional variations in the prevalence of sickle cell disease and β-thalassemia in Saudi Arabia: Findings from the premarital screening and genetic counseling program. J Epidemiol Glob Health. 2011

2- AlSaleh KA, Al-Numair N, AlSuliman A, Zolaly M, Albanyan AM, AlOtaishan N, Abudouleh E, Bayoumy N, Tarawah A, AlZahrani F, AlAllaf F, AlMomen AK, Sajid R, Owaidah TM. Prevalence of coagulation factor deficiency among young adults in Saudi Arabia: A national survey.TH Open. 2020.

3- Fatima Madkhaly, Abdulaziz Alshaikh, Hala Aba Alkhail, Randa Alnounou, Tarek Owaidah. Prevalence of positive factor V Leiden and prothrombin mutations in samples tested for thrombophilia in Saudi Arabia. Am J Blood Res. 2021.

4- Royal College of Physicians and Surgeons of Canada. Objectives of Training in the Specialty of Hematopathology. 2013.

5- https://path.upmc.edu/fellowship/hemato-path/training.htm. University of Pittsburgh Dept. of Pathology website.

6- Program Requirements for GME in Hematology Pathology - ACGME Handbook.
7- Sherrie L. Perkins, Vishnu B.V. Reddy, Kaari K. Reichard, Mary Ann Thompsen, and Cherie H. Dunphy. Recommended curriculum for teaching hematopathology to subspecialty hematopathology fellows. Society for Hematopathology Education Committee. Am J of Clin Pathology. 2007.
8- Dept. of Pathology and Laboratory Medicine. Anatomic Pathology Residency Training Manual. University of Ottawa.
9- Association of Directors of Anatomic and Surgical Pathology. Curriculum content and evaluation of resident competency in anatomic pathology: A proposal. Hum Pathology, Nov; 34(11):1083–90, 2003.
10- Dept. of Pathology and Laboratory Medicine. Anatomic Pathology Residency Training Manual: 2014–2015. University of Alberta.