SPECIFIC REQUIREMENTS AND GUIDELINES
FOR
THE RESIDENT TRAINING PROGRAM
IN
HEMATOLOGICAL PATHOLOGY
AT THE
UNIVERSITY OF OTTAWA

PROGRAM OBJECTIVES AND ROTATIONS

Revised: August 9, 2016
### Hematological Pathology: 4 year Program Rotations

**Time:** each block = 4 weeks

#### 1st Year
- **Block 1:** Lab, 4 weeks  
  Introduction to the Hematological Laboratory
- **7 Clinical Blocks (Blocks 2 to 8):**
  - **Block 2:** 4 weeks  
    Internal medicine clinical teaching unit (CTU)
  - **Block 3:** 4 weeks  
    Infectious diseases
  - **Block 4:** 4 weeks  
    Pediatric clinical hematology/oncology
  - **Block 5:** 4 weeks  
    Hematology (inpatient wards – malignant)
  - **Block 6:** 4 weeks  
    Hematology (inpatient wards – benign)
  - **Block 7:** 4 weeks  
    Hematology (thrombosis clinics/consults)
  - **Block 8:** 4 weeks  
    Hematology (bone marrow transplantation ward)
  - **Block 9:** 4 weeks  
    Hemostasis (clinical/lab rotation)
  - **Block 10:** 4 weeks  
    Morphology (PB/bone marrow/body fluids)
  - **Block 11:** 4 weeks  
    Transfusion Medicine
  - **Block 12:** 4 weeks  
    Hemostasis (clinical/lab rotation)
  - **Block 13:** 4 weeks  
    Introduction to Lymph nodes: Lymphoma pathology

#### 2nd Year
- **Page 39**
  - **8 weeks:** Morphology
  - **8 weeks:** Transfusion Medicine
  - **8 weeks:** Coagulation
  - **8 weeks:** Lymph nodes: Lymphoma Pathology
  - **4 weeks:** Introduction to Hemoglobinopathies
  - **4 weeks:** Molecular Diagnostics
  - **4 weeks:** Flow Cytometry
  - **4 weeks:** Cytogenetics
  - **4 weeks:** Pediatric Hematology Laboratory, junior rotation

#### 3rd Year
- **Page 93**
  - **4 weeks:** Transfusion Medicine
  - **8 weeks:** Lymphoma Pathology
  - **4 weeks:** Apheresis & Stem cells
  - **8 weeks:** Coagulation
  - **12 weeks:** Morphology
  - **4 weeks:** Flow Cytometry
  - **4 weeks:** HLA
  - **4 weeks:** Hemoglobinopathies
  - **4 weeks:** Laboratory Management/Quality Assurance

#### 4th Year
- **Page 127**
  - **Pediatric Hematology Laboratory, senior rotation**
  - **Lymph nodes/Lymphoma pathology**
  - **Hemoglobinopathies**
  - **Morphology**
  - **Transfusion Medicine**
  - **Elective or pre-exam study block**
  - **Research**
YEAR ONE

HEMATOLOGICAL PATHOLOGY

Program Rotations

1st Year
Block 1: Lab, 4 weeks Introduction to the Hematological Laboratory
7 Clinical Blocks (Blocks 2 to 8)
Block 2: 4 weeks Internal medicine clinical teaching unit (CTU)
Block 3: 4 weeks Infectious diseases
Block 4: 4 weeks Pediatric clinical hematology/oncology
Block 5: 4 weeks Hematology (inpatient wards – benign)
Block 6: 4 weeks Hematology (inpatient wards – malignant)
Block 7: 4 weeks Hematology (thrombosis clinics/consults)
Block 8: 4 weeks Hematology (lymphoma/myeloma clinic)
Block 9: 4 weeks Hemostasis (clinical/lab rotation)
Block 10: 4 weeks Morphology (PB/bone marrow/body fluids)
Block 11: 4 weeks Transfusion Medicine
Block 12: 4 weeks Hemostasis (clinical/lab rotation)
Block 13: 4 weeks Introduction to Lymph nodes: Lymphoma pathology
OUTLINE

Monday 08:30 Program Director’s Rounds
       09:15 Hemepath academic half day
Tuesday 08:00 Medical Grand Rounds
Thursday 08:00 Leukemia/Lymphoma Rounds
       13:00 Thrombosis Rounds
       14:00 Hematology Grand Rounds
Friday  12:00 Malignant Hematology Rounds

Each Wednesday afternoon attend one general hematology clinic to perform bone marrows. (with supervision from clinical hematologist)

Weekly Activities
1. Describes and reports peripheral blood and other laboratory tests.
2. Consults with clinical residents on problem cases.
3. Reviews clinical material of cases seen in the laboratory (hospital and clinic).
4. Becomes competent in performing bone marrow aspirates and biopsies.

OBJECTIVES
Developing the resident’s skills in morphologic interpretation of peripheral blood and bone marrow.

Incorporating clinical and ancillary laboratories testing information into peripheral blood and bone marrow reports.

Developing competency in performing bone marrow aspirates and biopsies.

Developing knowledge of inventory of products in the transfusion medicine laboratory.

Developing knowledge of test menu and collection tubes for coagulation testing.

MEDICAL EXPERT
1. Will learn the principles of operation of a microscope and the principles of staining and cytochemical staining.
2. Shall learn the principles of cell counters and their application to morphology.
3. Shall be able to separate an anemia into its morphologic type. Shall know the main causes of anemia and the likely clinical situations where these arise.
4. Shall be able to identify and assess artifacts in morphology.
5. Shall be able to recognize the peripheral blood findings in hemolytic anemia. Shall order additional investigations needed for elucidation of the cause of the anemia.
6. Shall recognize and be able to state the main causes of pancytopenia. Shall recommend appropriate additional investigations.
7. Shall recognize acute and chronic leukemia. Shall recommend additional testing appropriate to defining the particular type of acute leukemia and start to incorporate flow cytometry with immunophenotyping.
8. Shall become competent to do bone marrow aspiration and biopsy procedure.
9. Shall demonstrate knowledge of inventory of products in the transfusion medicine laboratory.
10. Shall demonstrate knowledge of test menu and collection tubes for coagulation testing.
COMMUNICATOR
1. Shall develop an approach to writing diagnostic comments on peripheral blood films. Shall make appropriate clinical recommendations. Shall suggest additional investigation where appropriate.
2. Shall be able to investigate the causes of polycythemia. Shall recommend appropriate additional testing.

COLLABORATOR
1. Working with the staff person to review initial interpretations and develop skills in interpretation.

LEADER
1. Develops skill in working closely with laboratory technical staff.

HEALTH CARE ADVOCATE
1. Responds in a positive way to any opportunities that may arise during the morphology rotation to improve the health of patients and communities.

SCHOLAR
1. Shall review the medical literature and make use of the library and electronic media.
2. Shall respond promptly and helpfully to requests for assistance.

PROFESSIONAL
1. Shall deliver the highest quality care by developing expertise in the accurate interpretation of peripheral blood and other laboratory tests.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.

COMPETENCY CHARACTERISTICS
By the end of the rotation, the resident should have:
1. Learned the basics of morphologic interpretation of peripheral blood and bone marrow.

EVALUATION
1. One presentation at academic half day and/or at Leukemia Rounds
2. Slide quizzes (2): one at mid rotation after 4 weeks and one at end of rotation.

REFERENCE MATERIALS
1. WHO Classification of Tumours of Haematopoietic and Lymphoid tissues. 4th edition. 2008
11.
INTRODUCTION

The discipline of hematopathology interacts with many clinical specialties. The most important is internal medicine and its specialties as well as obstetrics and pediatrics. The year of internal medicine allows the resident to interact with other residents, attending staff and patients. This will allow them to see how important laboratory information is in diagnosis and monitoring of patients illnesses.

The rotations have been selected to give our residents the best experiences that would be useful in their careers. They are on the service at the PGY1 level with responsibilities of that level. They are under the supervision of the departments that they rotate and undergo evaluation from them. This evaluation is sent to the home program and part of the training record. The residents give feedback on their rotations and their worth.

The rotations are:

- 4 weeks Internal medicine clinical teaching unit (CTU)
- 4 weeks Infectious diseases
- 4 weeks Pediatrics clinical hematology
- 8 weeks Hematology inpatient wards (benign 4 weeks, malignant 4 weeks)
- 4 weeks Hematology (thrombosis clinics/consults)
- 4 weeks Lymphoma/myeloma clinic
- 4 weeks Hematology (Bone marrow transplant)

These rotations are of a 4 week block with responsibilities to the division to which they are assigned. For all clinical hematopathology rotations, the resident will be take on-call (nights and weekends) for the clinical hematology service, as part of the regular on-call schedule. This provides invaluable clinical experience for the hematopathology resident.

Evaluation:
- ITERs at the end of each rotation.
- Taking the MCCQE-2 in October of 2nd year, after the completion of the year of internal medicine.
This is a core rotation for students and residents in internal medicine. The source of patients is predominately from the emergency department. The spectrum of illness is broad with medical problems often of multi system disease. These invariably have many laboratory abnormalities particularly of a hematological basis. They include undifferentiated problems, patients with renal failure, hepatic dysfunction, cardiac and respiratory problems as well as neurological problems. They all have hematologic aspects to their presentation that requires diagnosis and management. This includes laboratory testing, anticoagulation initiation and monitoring, and often transfusion issues. The service is a 24/7 operation and the residents appreciate the necessity of accurate and speedy information. The residents acknowledge this is a difficult rotation but all appreciate its worth. Assessments are from CTU medicine and sent to the base program director.

Medical Expert:
- Possess an appropriate level of knowledge of common admitting diagnosis on the CTU, including congestive heart failure, atrial fibrillation, angina and nonSTEMI, stroke, infection (cellulitis, osteomyelitis, meningitis, community acquired pneumonia, COPD exacerbation, asthma, urinary tract infection, diabetes, metabolic disorders (e.g. hyponatremia), thromboembolic disease, complication of alcohol and drug abuse, anaphylaxis/allergic complications of medications.
- Demonstrate an approach to undifferentiated illness presentations such as shortness of breath, hypoxia, decreased level of consciousness, shock, renal failure, GI bleeding, chest pain, abdominal pain, weakness, fever, hemoptysis, elevated INR, anemia, thrombocytopenia, metastatic malignancy of unknown primary, weight loss, joint pain, nausea and vomiting, diarrhea and constipation.
- Demonstrate the ability to perform a complete patient assessment including clinical history, physical examination, ordering of appropriate investigations, data interpretation and formulation of a differential diagnosis.
- Demonstrate knowledge appropriate to PGY1 including knowledge of practice guidelines for common medical conditions such as pneumonia, COPD, congestive heart failure, asthma, hypertension, stroke prevention; use and side effects of common medications such as diuretics, steroids, antibiotics, anti-thrombotics, insulin.
- Demonstrate knowledge for special care patients appropriate to PGY1 including end of life care and the elderly patient.
- Demonstrate clinical decision making skills appropriate to PGY1, including when to seek advice
- Demonstrate evolving knowledge base with respect to legal issues and medical ethics including informed consent, capacity and substitute decision making, confidentiality, and truth telling.
- Practice medicine in a way to enhance patient safety and reduce adverse events.
- Demonstrate proficiency in at least some of the following: thoracentesis, paracentesis, lumbar puncture, joint aspiration, EKG interpretation, blood gas.
- Acquire and practice effective teaching skills particularly in the areas of physical diagnosis, problem solving, differential diagnosis, and technical skills.
- Recognize and know the appropriate initial management of Medical emergencies.
- Develop the ability to function in the role of a consultant for junior house staff. In addition, Internal Medicine residents will function in the role of consultant to the Emergency Department, and other inpatient wards.

Communicator:
- Demonstrate appropriate communications skills in caring for the patient, documentation with progress notes, and dictated discharge summaries.
- Demonstrate the ability to write a concise consultation note and prioritize their recommendations on a consultation sheet.

Collaborator:
- Demonstrate the ability to work with others in the health care team.
- Demonstrate respectful attitudes towards other colleagues and members of the inter-professional team.

Leader:
- Demonstrate ability to manage their time and the time of others.
- Demonstrate ability to balance patient care and educational activities.
- Demonstrate ability to balance work and personal life.

Advocate:
- Demonstrate ability to advocate for their patients to improve their overall health.
- Demonstrate knowledge of patient safety issues and prevention of adverse events.

Scholar:
- Demonstrate ability to improve their knowledge and skills
- Demonstrate ability to assist others in learning
- Be able to ask clinical questions, perform a focused literature search and critically review the literature.

Professional:
- Demonstrate commitment to their patients, profession and society though ethical practice by demonstrating honesty, integrity, altruism and compassion.
- Demonstrate appropriate relationships with patients and interactions with members of the health care team.
- Communicating absences from CTU to attending MD and senior medical resident.
- Participation in the on-call system.
- Disclosing adverse events to health care teach and patient.
The infectious disease service does not have inpatient beds. It provides consultative services to the hospital patients and outpatient areas. Patients seen during this consultative rotation often have multi system manifestations of their conditions. During this rotation, there is also substantial overlap with the inpatient hematology service, as there are many patients with severe infections and profound neutropenia. Patients are seen in all areas of the hospital, providing the resident the opportunity to see the hematologic manifestations in virtually all departments and divisions of medicine and surgery. Clinical responsibilities and assessments are from the host division.

Medical Expert

The resident will demonstrate:
- basic knowledge of microorganisms and the kind of diseases that they may cause.
- knowledge of the antimicrobials that may be appropriate for treatment as they are applied to the clinical situation.
- use of this knowledge to determine the appropriate use of antimicrobials the relevance of culture results that have been obtained
- the formation of an appropriate plan of management

The resident will possess an appropriate level of knowledge of:
- The etiology, epidemiology, pathogenesis, natural history, pathology, clinical features, prevention and management of bacterial, viral, parasitic, fungal and mycobacterial infections including those occurring in the following special hosts: immigrants/refugees and travelers and immune-compromised hosts
- Clinical and laboratory approach and differential diagnosis of complex problems in which infections may play a role. such as: fever of unknown origin, acute rapidly progressive infectious illness, sepsis from an undefined site, sepsis with systemic inflammatory response syndrome and multiple organ dysfunction syndrome, pulmonary infiltrates of uncertain etiology, post-operative fever, recurrent/relapsing infections/fever, febrile neutropenia
- The study of microbe particles with an understanding of pathology, virulence factors, life cycles, taxonomy structure/physiology pathogenesis
- Immunology including:
  - Details of innate and adaptive immunity
  - Pathogenic mechanisms by which immune responses facilitate or prevent disease including the role of cytokines
- Environmental and behavioural interventions (e.g. handwashing, sterilization)
- Surveillance for nosocomial infection and infections of public health importance
- Antimicrobials and other therapies in infectious diseases including classification, pharmacokinetics and pharmacodynamics in the normal and abnormal host, mechanism of action, mechanism of resistance, toxicity and drug interactions, clinical indications and use, principles of pharmacoconomics,
- Principles of epidemiology as they relate to infectious diseases including characteristics of diagnostic tests, for example sensitivity, specificity and positive predictive value, basics of study design, critical appraisal and outbreak investigation

COMMUNICATOR

To provide humane, high-quality care, and to establish effective relationships with patients other physicians and other health professionals. Communication skills are an essential part of working in the health care team. Communication skills are necessary for obtaining information from, and conveying information to patients and their families. Furthermore, these abilities are critical in eliciting patients' beliefs, concerns, and expectations about their illnesses, and for assessing key factors impacting on the patients' health.

COLLABORATOR

It is essential to have effective collaboration with patients and the multidisciplinary team of expert health professionals for provision of optimal patient care, education and research.

LEADER

Specialists require the abilities to prioritize and effectively execute tasks through teamwork with colleagues and make systematic decisions when allocating finite health care resources.

HEALTH ADVOCATE
Residents on the infectious diseases service are expected to:
- identify the important determinants of health affecting patients.
- contribute effectively to improved health of patients and communities.
- recognize and respond to those issues where advocacy is appropriate.
- promote the health of individual patients and the population.

SCHOLAR
Residents on the infectious diseases service are expected to:
- develop, implement and monitor a personal continuing education strategy to establish a practice of lifelong learning.
- critically appraise sources of medical information.
- facilitate learning of patients, house staff/students and other health professionals.

PROFESSIONAL
Residents on the infectious diseases service are expected to:
- be committed to the highest standards of excellence in clinical care and ethical conduct, and to continually perfecting mastery of their discipline
OUTLINE

Monday:  
08:00 – 13:00 Oncology Clinic  
13:00 – 16:00 Bone Marrow Transplant  
13:00 – 16:00 Sickle Cell /Thalassemia clinic  
16:00 – 17:00 Tumor Board (1st, 3rd, 5th)  
16:00 – 17:00 Division Journal Club 2nd, bi-monthly alternates with M&M rounds  
16:00 – 17:00 M&M Rounds, 2nd, bi-monthly alternates with Divisional Journal Club  
16:00 – 17:00 Fellowship Journal Club, 4th

Tuesday:  
08:00 – 13:00 Oncology Clinic  
13:00 – 16:00 Clot Clinic  
13:00-16:00 Hem/Gyne clinic (once per month)

Wednesday:  
08:30 – 09:30 Grand Rounds, Dept of Pediatrics  
08:00 – 13:00 Oncology Clinic  
13:00 – 15:30 After Care Clinic  
13:00 – 16:00 Neuro-oncology clinic  

Thursday:  
08:00 – 13:00 Oncology Clinic  
13:00 – 15:00 Hemophilia or von Willebrand clinic (1st and 3rd month)  
13:00 – 16:00 0-24 Off Treatment Clinic

Friday:  
08:00 – 13:00 Hematology clinic  
08:00-13:00 Oncology Clinic  
14:00 – 15:00 Team rounds – inpatient and outpatient service

OBJECTIVES

This clinical pediatric rotation within the Internal Medicine Year compliments the residents’ pediatric laboratory rotation. In this rotation, the focus is more on clinical experience. The objective is to provide the resident with the knowledge, clinical experience and skills to diagnosis and manage children and newborns with hematological and oncological disorders.

The resident is expected to:
1. Know the common Hematological and Oncological disorders of children and newborns.  
2. Acquire the experience and skills to diagnosis and manage these children and newborns.  
3. Recognize the devastating impact of cancer and other lifelong congenital disorders (e.g. Sickle Cell, Thalassemia Major, etc) on these children and their families.
4. Experience the practice of comprehensive team care in pediatrics and its value in providing a wide range of medical and psychosocial support to these children and families.

5. Be aware of the advances in the management of these disorders and the use of treatment protocols by the Children’s Oncology Group (USA) to treat childhood cancer.

MEDICAL EXPERT
The Division of Hematology / Oncology is a member of the Children’s Oncology Group (USA) participating actively in their study protocols. The subspecialty programs in oncology, thrombocytopenia, hemophilia, sickle cell, thalassemia and bone marrow transplant are associated with national and international study groups and active in their treatment and research protocols.

Residents will attend the Oncology and Hematology clinics and see a wide range of Hematology and Oncology patients and newborns under the supervision of the attending Hematologist / Oncologist. They will enhance their medical knowledge and professional skills by seeing a large number of new patients, consultations and follow-up cases. They are responsible to organize and follow up on all tests and perform procedures such as bone marrow and lumbar puncture procedures as well as participate in counseling sessions with patients and families. The resident will learn by discussing test results with pediatric specialists in the pathology, hematology and radiology departments. The resident will learn the latest advancements in diagnosis and management in leukemia and other childhood cancers using the COG protocols.

COMMUNICATOR/COLLABORATOR
As the resident will be working closely with members of the comprehensive care teams they will continue to develop their communication and collaboration skills.

In the treatment of children with cancer and life-long genetic defects such as sickle cell and hemophilia, the resident will participate as a patient advocate for the interest and welfare of these and other subspecialty groups. Residents will learn to appreciate the ethical issues when discussing palliative care, choices of investigational therapies and quality of care/life issues.

SCHOLAR
To improve scholastic performance, attendance is required at:

• Hematology/oncology team rounds; weekly, Fridays, 14:00 hrs. – 15:00 hrs.
• Hematology/Oncology Tumor Board; 1st, 3rd and 5th Monday, 16:00 hrs. – 17:00 hrs.
• Hematology/Oncology Journal Club, 2nd Monday, bi-monthly alternating with M&M rounds
Four Weeks Pediatric Clinical Hematology Year 1 CHEO

- Hematology/Oncology M&M Rounds; 2nd Monday, bi-monthly alternating with Division Journal Club
- Hematology/Oncology Fellowship Journal Club; 4th Monday
- Dept. of Pediatrics Grand Rounds weekly; Wednesday, 08:30 hrs. – 09:30 hrs.

Teaching:

- Assigned topics to present at teaching sessions;
- Patient case presentation/discussions at team rounds / tumor board / clinic etc.;
- May be assigned to present at Fellowship Journal Club.

EVALUATION

At end of rotation by attending Hematologist/Oncologist.

RESOURCES (CHEO)

The resident will participate in the services provided by:
- Hematology laboratories;
- Transfusion Medicine services; and
- the clinical programs of the Division of Hematology/Oncology

LABORATORY SERVICES at CHEO include:

a. General hematology: CBC, morphology, coagulation screening
b. Special hematology: Bone marrow, special histochemistries, hemoglobinopathies, RBC enzymes, Osmotic fragility, neutrophil function etc.
c. Coagulation/ thrombophilia / platelet studies
d. Immunohematology – transfusion / blood bank / flow cytometry

REFERENCE MATERIALS
1. Nathan/Oski – Hematology of Infancy and Childhood, 5th Ed., CHEO Library
2. Pizzo/Poplak – Pediatric Hematological Malignancies, CHEO Library
APPENDIX I – For Reference Use (List of Hematological and Oncological Disorders)

Hematologic Disorders of Newborns:
Neonatal Thrombocytopenia – PLAI – Antigen/ITP
Hemorrhagic disease of the newborn
Neonatal sepsis/DIC/purpura fulminans
Hyperbilirubinemia and kernicterus/exchange transfusion/phototherapy
Isoimmunization – ABO incompatibility – Rh incompatibility
ABO incompatibility
Anemia of prematurity
Hemolytic anemia

Common Pediatric Hematological Disorders:
- Anemia – Congenital
- Bone Marrow Failure Syndromes:
  - Fanconi Anemia
  - Diamond Blackfan
  - Radial Platelet syndrome (TAR)

Red Cell Membrane Defects:
- Congenital Spherocytosis

Red Cell Enzyme Defects:
- Glucose – 6 phosphate dehydrogenase deficiency
- Pyruvate Kinase deficiency

Hemoglobinopathy:
- Beta Thalassaemia
- Hemoglobin E Thal

Anemia – Acquired:
- Nutritional Iron deficiency
- Hemolytic Uraemic syndrome
- Microangiopathy
- Hypersplenism
- Idiopathic Aplastic Anemia
- Auto Immune Hemolytic Anemia

Common Pediatric Hematological and Oncological disorders.
Leukocyte disorders:
- Neutropenia: congenital and acquired
- Neutrophil function defects
- Use of GCSF
- Chronic Granulomatous disease
- Leukocytosis – Sepsis
- Leukaemoid reactions
Platelet Disorders:

- Thrombocytopenia
- Immunological (ITP)

Coagulation Defects.

Congenital:

- Hemophilia A/B
- von Willebrand’s disease
- Thrombocytopenia
- Anti Thrombin III and Protein C/S
- Thrombophilia

Acquired:

- Vitamin K disorders/liver disease
- Anticoagulant overdose
- Disseminated intra-vascular coagulopathy (DIC)

Common Pediatric Malignancies

- Acute leukemia
  - Lymphoblastic
  - Myelogenous
- Myelodysplasia syndromes
- Brain tumours
- Wilms tumour
- Lymphomas/Hodgkins disease
- Neuroblastoma
- Ewings sarcoma
- Primitive Neuroectodermal tumours (PNET)
- Rhabdomyosarcoma
- Osteogenic sarcoma
- Teratoma, Germ Cells
- Retinoblastoma
This rotation gives the trainee a chance to be involved in the clinical management of patients with hematological malignancies requiring admission to hospital. The resident is involved in the clinical and laboratory testing of these patients. This provides the opportunity to see and discuss approaches to these conditions.

The interaction includes all disciplines of the hematology laboratory. These include flow cytometry, DNA analysis, peripheral blood morphology as well as bone marrow aspirate and biopsy evaluation. There is much use of transfusion of all blood products and the residents are exposed to all issues of transfusion medicine as it is practiced.

This in-patient ward is an experience of with patients with hematological malignancy where the patient’s condition requires hospital admission. Here the resident learns the importance of monitoring diseases with testing to assess complications and staging of diseases.

OBJECTIVES

Medical Expert
- Gain experience in the clinical approach to diagnosis of suspected hematological malignancy in the in-patient setting.
- Gain experience in managing common complications associated with the treatment of hematological malignancies, including tumour lysis, transfusion support and febrile neutropenia.

Communicator
- Obtain relevant history from patients
- Develop expertise in communicating difficult news (e.g. complications of treatment, end-of-life decisions)
- Communicate effectively with consultant physicians
- Effectively communicate clinical information to attending physician and other collaborating members of the health care team (both in writing and orally)

Collaborator
- With a team approach, collaborates effectively with attending physicians, consultants and other members of the health care team, in the diagnosis and management of inpatients

Leader
- Utilize in-patient resources effectively to manage patients
- Arrange for efficient transitions between in-patient and out-patient care for individual patients
Health Advocate
- Adapt clinical management to the patients' social circumstances.
- Involve the patient and family members in treatment decision-making

Scholar
- Demonstrate an effective personal education strategy
- Appropriately use the literature in an evidenced-based approach to the management of in-patients
- Identify gaps in knowledge and expertise and work to increased knowledge in these areas

Professional
- Provide high quality care with integrity, honesty and compassion.
This rotation gives the trainee a chance to be involved in the clinical management of hematology patients requiring admission to hospital. The resident is involved in the clinical and laboratory testing of these patients. This provides the opportunity to see and discuss approaches to these conditions.

The interaction includes all disciplines of the hematology laboratory. These include hemoglobinopathy investigation, DNA analysis, peripheral blood morphology as well as bone marrow aspirate and biopsy evaluation. There is much use of transfusion of all blood products and the residents are exposed to all issues of transfusion medicine as it is practiced.

This in-patient ward is an experience of with patients with non-neoplastic hematological disorders such as hemophilia, sickle cell disease, ITP, TTP, where the patient’s condition requires hospital admission. Here the resident learns the importance of monitoring diseases with testing to assess complications.

**OBJECTIVES**

**Medical Expert**
- Gain experience in managing non-neoplastic hematological disorders requiring hospital admission.
- Gain experience management of patients with hematological disorders with acute issues arising during overnight on-call.

**Communicator**
- Obtain relevant history from patients
- Develop expertise in communicating difficult news (e.g. complications of treatment, end-of-life decisions)
- Communicate effectively with consultant physicians
- Effectively communicate clinical information to attending and other collaborating physicians (both in writing and orally)

**Collaborator**
- With a team approach, collaborates effectively with attending physicians, consultants and health care workers, in the diagnosis and management of inpatients

**Leader**
- Utilize in-patient resources effectively to manage patients
- Arrange for efficient transitions between in-patient and out-patient care for individual patients
Health Advocate
- Adapt clinical management to the patients’ social circumstances.
- Involve the patient and family members in treatment decision-making

Scholar
- Demonstrate an effective personal education strategy
- Appropriately use the literature in an evidenced-based approach to the management of in-patients
- Identify gaps in knowledge and expertise and work to increased knowledge in these areas

Professional
- Provide high quality care with integrity, honesty and compassion.
This is predominately an out-patient experience. The Ottawa Hospital has a long standing, internationally recognized, clinical and research acclaimed service. The residents assess referred patients for acute thrombotic problems that include DVT and or pulmonary embolism. They are involved with initial assessment, diagnosis and initial treatment. They learn the action of various heparins and oral anticoagulants. They learn how to monitor for efficacy and complications. The residents are also involved with in-patient consultations as well as pre and postoperative thrombosis problems. They are exposed to the practical as well as research issues regarding thrombophilia testing. This rotation bridges very well the interrelationship of clinical and laboratory overlap with complementary issues. During this four week rotation, the Hematopathology resident is expected to participate in the clinical hematology on-call schedule for night-time and weekend on-call coverage.

**Rounds: Thrombosis Rounds Thursdays 1pm – 2pm, OBDC Conference Room 2247**

**Medical Expert**
- Development of consultant skills, including:
  i. focused history and physical examination
  ii. synthesis of key hematological issues
  iii. formulation of differential diagnosis
- Demonstrate knowledge of hypercoagulability work-up
- Demonstrate knowledge of the principles of management of venothromboembolic disease

**Communicator**
- Communicate effectively with referring physicians orally and in writing regarding impressions and management plan
- Communicate in a compassionate way with patients and their families

**Collaborator**
- Collaborate effectively within the multidisciplinary circle of care

**Scholar**
- Read around each consult to increase knowledge and understanding
- Critically appraise relevant literature and apply it the consult case
- Demonstrate a continuing self-education plan

**Leader**
- Work effectively with team members, including organization, supervision and delegation where appropriate
- Work with the supervising physician to triage consults for effective time-management and patient prioritization
Health Advocate
- Involve the patient and patient’s family in treatment decision, and take into consideration the patient’s social circumstances when making treatment decisions.
- Select appropriate investigations in a resource-effective and ethical manner, especially for hypercoagulability work-up

Professional
- Deliver the highest quality care with integrity, honesty and compassion.
- Exhibit appropriate personal and interpersonal professional behaviors.
- Respect diversity of age, gender, disability, intelligence and socioeconomic status.
This rotation gives the trainee a chance to be involved in the clinical management of patients undergoing bone marrow transplantation. The resident is involved in the clinical and laboratory testing of these patients. This provides the opportunity to see and discuss approaches to these conditions.

The interaction includes all disciplines of the hematology laboratory. These include flow cytometry, DNA analysis, peripheral blood morphology as well as bone marrow aspirate and biopsy evaluation. There is much use of transfusion of all blood products and the residents are exposed to the clinical practice of transfusion medicine as it pertains to the unique needs of the bone marrow transplant patient.

The inpatient ward is an experience of with patients admitted to the bone marrow transplant service.

OBJECTIVES

Medical Expert
- Gain experience in the supportive care required for bone marrow transplantation with respect to medical, psychological, nutritional, social, economic realms
- Gain experience in the clinical management of organ-specific toxicities, infection, failed engraftment, late graft rejection

Communicator
- Obtain relevant history from patients
- Develop expertise in communicating difficult news (e.g. complications of treatment, end-of-life decisions)
- Communicate effectively with consultant physicians
- Effectively communicate clinical information to attending and other collaborating physicians (both in writing and orally)

Collaborator
- With a team approach, collaborates effectively with attending physicians, consultants and health care workers, in the diagnosis and management of bone marrow transplant patients

Leader
- Utilize inpatient resources effectively to manage patients
- Arrange for efficient transitions between in-patient and out-patient care for individual patients
Health Advocate
- Adapt clinical management to the patients’ social circumstances.
- Involve the patient and family members in treatment decision-making

Scholar
- Demonstrate an effective personal education strategy
- Appropriately use the literature in an evidenced-based approach to the management of in-patients
- Identify gaps in knowledge and expertise and work to increased knowledge in these areas

Professional
- Provide high quality care with integrity, honesty and compassion.
OUTLINE
Monday  08:30  Program Director’s Rounds
         09:15  Hemepath academic half day
Tuesday  08:00  Medical Grand Rounds
Thursday  08:00  Leukemia/Lymphoma Rounds
          13:00  Thrombosis Rounds
Friday   12:00  Clinical Hematology Rounds

OBJECTIVES
1. To learn to read normal marrows, evaluate erythropoiesis, granulopoiesis etc.
2. To learn what is a normal profile in adult, children and neonates.
3. To learn about various lymphocytes, left shift, CLL, CGL, acute leukemia, NRBC/WBC
corrections, rouleaux, agglutination, hypochromia, dimorphic picture, macrocytic,
spherocytosis, blister, fragmentation, leukoerythroblastic, ITP and TTP.
4. To learn what constitutes critical CBC values.
5. To consolidate expertise in how to do bone marrow aspirates and biopsies. Procedures
   may be done in conjunction with clinical hematology on Wednesday with supervision by
   clinical hematologists.

MEDICAL EXPERT
1. To learn the principles of morphology of different hematological diseases in bone marrows
   and to identify metastasis in the marrows.
2. To be able to identify granulomatous disease, amyloidosis and Gaucher’s disease in bone
   marrows.
3. To learn about bone pathology, normal bone marrow biopsies and abnormal bone marrow
   biopsies.
4. To learn to identify metastatic disease in a marrow.
5. Shall produce reports on bone marrow smears, marrow biopsies and films from other body
   sites. Shall recognize significant abnormalities and record them. Shall make appropriate
   recommendations about further investigations.
6. Shall perform bone marrow aspirates and biopsies and obtain satisfactory specimens.
7. To learn to identify bone pathology.
8. To consolidate expertise in the procedure for bone marrow aspirates and biopsies.

COMMUNICATOR / COLLABORATOR
1. To become proficient in writing clear reports to convey the important features to the
   receiving physician.
2. To call ordering physician for preliminary results if urgency required
3. To communicate effectively and professional with laboratory staff for additional special
   testing on specimen.
4. Demonstrate ability to use LIS/Powerpath for writing marrow reports.
LEADER
1. Develops skill in working closely with laboratory technical staff

HEALTH CARE ADVOCATE
1. Makes selection of cases for further diagnostic testing
2. Responds positively to interpretive possibilities during the rotation to improve patient health

SCHOLAR
1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on a peripheral blood morphology topic. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL
1. Shall deliver the highest quality care by developing expertise in morphology
2. Shall respond promptly and helpfully to requests for assistance
3. Shall work effectively and collaboratively with laboratory staff

COMPETENCY CHARACTERISTICS
By the end of the rotation, the resident should:
1. Have refreshed skills in peripheral blood morphology
2. Be able to interpret all peripheral blood that are processed
3. Be able to interpret routine bone marrow aspirate and biopsies of common conditions

EVALUATION
1. Successful completion of the self-assessment cases (see recommended texts below).
2. Evaluation of seminar presentation.
3. Glass slide quiz

REFERENCE MATERIALS
OUTLINE
Monday 08:30 Program Director’s Rounds
       09:15 Hemepath Academic half day
Tuesday 08:00 Medicine Grand Rounds
       08:00 Leukemia/Lymphoma Rounds
       13:00 Thrombosis Rounds
Friday  11:30 OBDC Conference Room L2247
       12:00 Clinical Hematology Rounds
Weekly (Tuesday) 12:00 CBS Transfusion Medicine Residents Rounds (teleconference)
Monthly (Thursday) 12:00 U of T rounds (videoconference)

OBJECTIVES
1. To understand basic TM serological tests: ABO typing, Rh typing, antibody screen, antibody panel, DAT
2. To have an approach to the investigation of transfusion reactions
3. To have an approach to blood component therapy, based on published transfusion guidelines

MEDICAL EXPERT
1. To learn ABO inheritance and biochemistry
2. To learn Rh inheritance and biochemistry
3. To learn how to interpret DAT
4. To develop an approach to interpretation of antibody screen and panel
5. To learn the pathophysiology and presentations of transfusion reactions
6. To acquire knowledge re recommendations for blood component therapy

COMMUNICATOR / COLLABORATOR
1. To become proficient in understanding the basics of TM lab testing
2. To communicate effectively and professional with laboratory staff
LEADER
1. Develops skill in working closely with laboratory technical staff

HEALTH CARE ADVOCATE
1. Responds positively to possibilities during the rotation to improve patient health

SCHOLAR
1. Shall review transfusion guidelines

PROFESSIONAL
1. Shall work effectively and collaboratively with laboratory staff

COMPETENCY CHARACTERISTICS
By the end of the rotation, the resident should:
1. To understand basic TM serological tests: ABO typing, Rh typing, antibody screen, antibody panel, DAT
2. To have an approach to the investigation of transfusion reactions
3. To have an approach to blood component therapy

EVALUATION
1. Successful completion of Bloody Easy LITE for Physicians

REFERENCE MATERIALS
1. Bloody Easy LITE for Physicians http://belite.transfusionontario.org/
OBJECTIVES

The evaluation of patients with hemorrhagic or thrombotic complications is a stepwise process involving the clinical history, physical examination and a rational series of laboratory testing. Skills required by the coagulation consultant start with the patient evaluation, extend into the diagnostic laboratory and come full circle to the patient with recommendations for therapy. Hematopathologists play a vital role in this process by enabling accurate and timely laboratory investigations which are appropriately reported to clinicians caring for patients with hemostatic and thrombotic conditions. To strengthen coagulation consultation skills, for the first 4 weeks of this rotation, the hematopathology resident will participate in bleeding disorder clinics, rounds and consults, as listed below.

Clinics.
- Tuesday afternoons, starting around 1:45pm, Module H. Hemophilia/hemostasis clinics, usually 3 or 4 Thursday afternoons per month.

Rounds/meetings.
- Resident to attend weekly hemostasis team meeting on Monday mornings from 11 – 12, conf room L2247.
- Resident to attend weekly Thrombosis rounds. Thursdays, 1 – 2pm, room L2247 conference room.

Consults.
- Resident to take daytime on call for hemostasis, participate in daytime clinical wards consults and follow hemostasis in-patients at the General Campus.

OUTLINE

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>TOPIC</th>
<th>LAB COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Overview of hemostasis</td>
<td>1. Prothrombin time and Activated partial thromboplastin time and 50:50 mix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Thrombin Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Fibrinogen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. D-Dimer (whole blood agglutination method and immuno-turbidimetric method)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The above tests should be performed manually or observed at the Routine Coag bench. As well, the resident will learn the principles of how coagulation instruments work (weeks 1 – 3), and quality issues in the hemostasis lab.</td>
</tr>
</tbody>
</table>
### Introduction

Drs. Saidenberg, Tinmouth, Giulivi and Marisa Freedman MLT, ART

### PERIOD | TOPIC | LAB COMPONENT
--- | --- | ---

#### Week 2
**Inherited deficiencies of clotting factors**
- Hemophilia A
- Hemophilia B
- Rare clotting factor deficiencies

1. Factor assays
2. Inhibitor detection by mixing studies and by Bethesda Unit method
3. Genetic testing for inherited coagulation disorders
The above tests will be performed manually by the resident.

#### Week 3
**Von Willebrand’s Disease**

1. von Willebrand Factor Antigen
2. Von Willebrand Multimers
3. Ristocetin CoFactor

#### Week 4
**Platelet physiology**
Disorders of platelet number and function

1. Platelet Aggregation & release
2. Platelet electron microscopy
3. Flow cytometry of platelets
4. HIT investigations
The above tests will be performed or observed by the resident using standard methodology.

#### Week 5
**Natural inhibitors of coagulation**
Lupus Anticoagulant

1. Protein C
   a. Clottable
   b. Chromogenic
   c. Immunologic
2. Protein S
   a. Functional
   b. Immunologic
3. AT
   a. Functional
   b. Immunologic
4. FV Leiden
   a. APCR
   b. Genetic
5. PT gene mutation
6. APLA
   a. Screening test
   b. Mixing tests
   c. Confirmatory tests
   d. ELISAs
**PERIOD** | **TOPIC** | **LAB COMPONENT**
---|---|---
Week 6 | Acquired coagulation disorders  
- Liver disease  
- Vitamin K deficiency  
- DIC | 1. Molecular biology assays  
2. Western Blot assays

Week 7 | The fibrinolytic system  
Special hemostasis topics | 1. Plasminogen  
2. α2-antiplasmin  
3. Euglobulin clot lysis  
4. D-dimer  
5. FDP  
6. TCT w/out CaCL1  
7. Reptilase  
8. Urea clot solubility  
9. Immuno and chromogenic FXIII assays  
10. Cryofibrinogens

Week 8 | Acquired disorders of coagulation  
- Liver disease  
- Vitamin K deficiency  
- DIC |
## Introduction

The resident will demonstrate diagnostic and therapeutic skills for hemostatic or thrombophilic disorders. Areas of particular importance that will be covered in this rotation include technical aspects, quality issues in testing and clinical applications of the following conditions and diseases:

1. Hemostatic testing and laboratory interpretation.
2. A systemic approach to the bleeding patient
3. Hemophilia A and B
4. Other congenital disorders of hemostasis.
5. Inhibitors of coagulation
6. Von Willebrand Disease
7. Disorders of Platelet Function
8. Immune thrombocytopenic purpura
9. Disseminated Intravascular Coagulation
10. Inherited thrombophilias
13. Thrombocytosis and thrombocytopenia
14. Antiphospholipid syndrome
15. Hemostatic and thrombotic disorders in malignancy
16. Heparin induced thrombocytopenia
17. Antithrombotic and thrombolytic agents
18. Transfusion medicine and hemostasis
19. Coagulation complications of pregnancy

<table>
<thead>
<tr>
<th>ROLES</th>
<th>OBJECTIVES</th>
<th>STRATEGIES</th>
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</thead>
<tbody>
<tr>
<td>Medical Expert</td>
<td>The resident will demonstrate diagnostic and therapeutic skills for hemostatic or thrombophilic disorders. Areas of particular importance that will be covered in this rotation include technical aspects, quality issues in testing and clinical applications of the following conditions and diseases:</td>
<td>• Observe and perform laboratory tests.</td>
</tr>
<tr>
<td></td>
<td>1. Hemostatic testing and laboratory interpretation.</td>
<td>• Prepare weekly presentations.</td>
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<tr>
<td></td>
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<td>• Assist with interpretation of laboratory tests.</td>
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**Eight Weeks**  
**Coagulation-Hemostasis**  
**Introduction**  

*Drs. Saidenberg, Tinmouth, Giulivi and Marisa Freedman MLT, ART*

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| Communicator  | • Develop skills for productive interaction with technologists and technicians in the laboratory  
                 • Develop skills to communicate effectively with clinicians caring for patients with hemostatic/thrombotic conditions | • The resident will be encouraged and expected, on a one-to-one basis, to collaborate and communicate with the technical staff and the supervisor on a daily basis.  
                 • Communicate abnormal results to clinicians when indicated  
                 • Enhance presentation skills through weekly presentations |
| Collaborator  | • During this rotation the resident will consult and collaborate with other health care workers regarding diagnostic and therapeutic issues related to hemostasis and thrombosis  
                 • Resident is expected to contribute to interdisciplinary team activities | • Provide verbal or formal consultation for physicians regarding clinical significance of test results and assist to develop a care plan for the patient.  
                 • Advise laboratory staff to initiate additional testing if required.  
                 • Recommend treatment options.  
                 • Present rounds on a clinical case to staff of special hematology laboratory |
| Leader        | • The resident will demonstrate proper selection, handling and preparation of specimens and controls for the methodologies current in the lab. The resident will analyze, prepare and sign out reports generated in the lab under supervision.  
                 • Overview of QA/QC procedures specific to the test procedures used. | 1. The resident will have discuss utilization of resources, budgetary considerations, and the utilization of new technology in weekly presentations as well as in person with laboratory staff, with the aim of developing managerial skills. |
Eight Weeks
Coagulation-
Hemostasis

Introduction

Drs. Saidenberg, Tinmouth, Giulivi and Marisa Freedman MLT, ART

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| Scholar      | 1. Resident should recognize gaps in knowledge and develop strategies to fill gaps through self-directed learning and consultation with other members of the health care team | • Schedule reading timetable and comply with schedules  
• Learn to effectively utilize tools such as Medline |
|              | 1. Develop critical appraisal skills specific to the literature regarding blood coagulation and hemostasis |                                                                                                       |
| Professional | • Understand the professional, legal and ethical codes to which physicians are bound  
• Provide appropriate follow up to abnormal test results and order additional testing as appropriate | • The resident should recognize his or her own limitations and ask for advice when needed  
• Respond appropriately to constructive feedback |
| Health Advocate | • Advocate for improved access to diagnostic services                       |                                                                                                       |

COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:

1. Knowledge of the principles and procedures of various coagulation methods.
2. Knowledge of specimen requirements and handling for various tests currently in use in the lab.
3. An understanding of how various coagulation methods are applied to clinical medicine.
4. An understanding of what information is required by the clinicians and be able to independently interpret the results generated in the lab.

EVALUATION

Regular topic presentations.  
Residents to complete 10 case report forms.  
Resident’s ability to correctly interpret lab results will be assessed during routine results interpretation sessions.
REFERENCE MATERIALS

1. Binder with objectives and reading material for the rotation is available from the supervisor.
2. Handouts covering main topics will be provided: publications & powerpoint presentations
3. Additional references and reading material available from the supervisor
4. Articles on USB key provided are considered required reading.

Recommended Text books:


OUTLINE

Monday  09:00  Autopsy Rounds, if hematologic cases
11:00  Attends pathology case presentation if hematologic
Thursday  08:00  Lymphoma Rounds
Thursday  14:00  Hematology Grand Rounds (if applicable)
Thursday  15:30  Morphology Rounds
Friday   12:00  Clinical Hematology Rounds

SPECIFIC OBJECTIVES

At the completion of training, the resident will have acquired the following competencies and will function effectively as:

MEDICAL EXPERT/CLINICAL DECISION-MAKER

General Requirements
1. To develop an algorithmic approach to diagnosis of lymphoproliferative disorders in a variety of organs based on histology and immunophenotype
2. Access and apply relevant information to clinical practice.
3. To develop a working knowledge of basic histology
4. To develop a working knowledge of WHO lymphoma classification

Specific Requirements
1. Demonstrate knowledge of normal anatomy, physiology and immunology of the lymphatic/immune system.
2. Demonstrate understanding of the general principles of embryologic development and the commoner variations of normal lymph nodes, spleen, thymus and bone marrow.
3. Demonstrate a superior and detailed knowledge of the normal gross and light microscopic appearance of lymph nodes, spleen and other lymphoid tissues.
4. Understand the basic principles of cell biology, immunology and pathogenesis, and the changes that occur in specific lymphomas.
5. Be familiar with the CD classification of lymphocyte antigens and their application to immunophenotyping of lymphoproliferative disorders.
6. Understand the principles of immunohistochemical diagnosis in malignant and inflammatory conditions.
7. Understand the principles of tissue processing and the use of different fixatives in the laboratory.
8. Demonstrate an in-depth knowledge of the appropriate processing and sampling of biopsy specimens for suspected lymphoma.
9. Understand the principles of nucleic acid-based molecular biology techniques and be familiar with their application to diagnosis in lymphoma diagnosis, especially the role of PCR and Southern blotting in gene rearrangement, lineage and specific translocation studies.

10. Understand the overall approach to examining a lymphoid organ microscopically, formulating a differential diagnosis based on histologic features and proceeding with the selection of confirmatory immunophenotyping.

11. Be familiar with the WHO classification of lymphoproliferative disorders and their clinical significance.

12. Understand the diagnostic pitfalls in interpreting biopsy tissues, including sample size, fixation problems, etc.

13. Demonstrate ability to take satisfactory gross and microscopic photographs of lymphoid tissues, including digital presentations of individual cases for teaching purposes.

14. Demonstrate working knowledge of basic histology.

COMMUNICATOR

General Requirements

1. Discuss cases with other members of the health care team in terms of diagnosis and prognosis.

Specific Requirements

1. Assist in the continuing education of physicians and other members of the hospital staff by participating in educational/clinical review forums such as lymphoma rounds.

2. Act as consultants to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.

3. Understand the information a pathology report should provide in a given clinical situation and be able to communicate it effectively in an oral and written form.

COLLABORATOR

General Requirements

1. Consult effectively with other physicians and health care professionals.

2. Contribute effectively to other interdisciplinary team activities.

3. Understand the role of the pathologist as “gate-keeper” in patients entering clinical trials

Specific Requirements

1. Must have experience in clinical medicine and surgery sufficient to achieve a sound understanding of the effects of disease and the role of pathology in its management.

2. Demonstrate the ability to advise on the appropriateness of obtaining histologic and cytologic specimens and following examination of these, to advise on further appropriate investigations.
LEADER

General Requirements

1. Utilize resources of the pathology laboratory effectively to achieve an accurate diagnosis.
2. Allocate finite health care resources wisely.
3. Work effectively and efficiently in a health care organization.
4. Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

1. Demonstrate knowledge of the methods of quality control in the laboratory as it relates to flow cytometry and immunohistochemistry of lymphoproliferative disorders.

HEALTH CARE ADVOCATE

General Requirements

1. Identify the important determinants of lymphoma pathogenesis and diagnosis.

Specific Requirements

1. As members of an interdisciplinary team of professionals responsible for individual and population health care, the anatomical pathologist will endeavour to help in informing the public about issues surrounding the diagnosis of lymphomas and risk factors for their development.

SCHOLAR

General Requirements

1. Develop, implement and monitor a personal continuing education strategy with respect to continuing education in lymphoma pathology.
2. Critically appraise sources of medical information and recognize the current best sources for lymphoma research reporting.
3. Facilitate learning of patients, house staff/students and other health professionals at rounds.
4. Contribute to development of new knowledge.
PROFESSIONAL

General Requirements

1. Deliver highest quality care with integrity, honesty and compassion.
2. Exhibit appropriate personal and interpersonal professional behaviours.
3. Practice medicine ethically consistent with obligations of a physician.
4. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

1. Act as an appropriate role model for students and others.
2. Demonstrate a professional attitude to colleagues, as well as to other laboratory staff.
3. Have an appreciation of the crucial role of the anatomical pathologist in providing quality patient care. This will include knowledge of individual professional limitations and the necessity of seeking appropriate second opinions.

KNOWLEDGE

1. Shall recognize tumors of lymphoid tissue and the main reactive condition of lymph nodes. Produce reports of these and signs them out with staff pathologist.
2. Correlates flow cytometry and DNA studies with morphologic findings and produces clinically relevant reports.

Assessment:

1. Review of slide box of basic histology (from Dr. Jason Wasserman)
2. Read book Chapters and complete of study questions form e-Study Guide of Histology for Pathologists, Chapter 1 Normal skin, Chapter 4 Bone, Chapter 9 Blood vessels, Chapter 31, lymph nodes.

References:

3. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues; 4th Edition; 2008
YEAR TWO

HEMATOLOGICAL PATHOLOGY

Program Rotations

If needed, residents write the MCCQE-II in October of 2nd year

Blocks 1 to 13 (52 weeks)

<table>
<thead>
<tr>
<th>2nd Year</th>
<th>Page 40</th>
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<tbody>
<tr>
<td>8 weeks</td>
<td>Morphology</td>
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<tr>
<td>8 weeks</td>
<td>Transfusion Medicine</td>
</tr>
<tr>
<td>8 weeks</td>
<td>Coagulation</td>
</tr>
<tr>
<td>8 weeks</td>
<td>Lymph nodes: Lymphoma Pathology</td>
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<tr>
<td>4 weeks</td>
<td>Introduction to Hemoglobinopathies</td>
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<tr>
<td>4 weeks</td>
<td>Molecular Diagnostics</td>
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<tr>
<td>4 weeks</td>
<td>Flow Cytometry</td>
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<tr>
<td>4 weeks</td>
<td>Cytogenetics</td>
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<tr>
<td>4 weeks</td>
<td>Pediatric Hematology Laboratory, junior rotation</td>
</tr>
</tbody>
</table>
OUTLINE

Monday 08:30  Program Director’s Rounds
09:15  Hemepath academic half day
Tuesday 08:00  Medical Grand Rounds
Thursday 08:00  Leukemia/Lymphoma Rounds
13:00  Thrombosis Rounds
Friday 12:00  Clinical Hematology Rounds

OBJECTIVES
1. To learn to read normal marrows, evaluate erythropoiesis, granulopoiesis etc.
2. To learn what is a normal profile in adult, children and neonates.
3. To learn about various lymphocytes, left shift, CLL, CGL, acute leukemia, NRBC/WBC corrections, rouleaux, agglutination, hypochromia, dimorphic picture, macrocytic, spherocytosis, blister, fragmentation, leukoerythroblastic, ITP and TTP.
4. To consolidate expertise in how to do bone marrow aspirates and biopsies. Procedures may be done in collaboration with the clinical hematologists on Wednesday's hematology clinic.
5. To learn about Hematology Analyzers, operation and quality control.

Expectations:
The resident is expected to spend most of the day in the multihead microscope room, Room 3882, to be readily available for review of peripheral blood and bone marrow slides with the hematopathology staff and clinical hematologists. It is the responsibility of the resident each day to summarize the clinical history and review the peripheral blood films, body fluid slides and bone marrows, and then present them to the staff hematopathology covering the lab each day.
The resident is expected to do at least one presentation, either at leukemia rounds or academic half day on a topic in morphology.

For graded responsibility:
- During the 5th to 8th weeks of this rotation, the resident will review and write comments on all PB/body fluid slides independently, and then bring all slides to staff hematopathology for final sign out.
- During the 5th to 8th weeks of this rotation, the resident will review and write at least 10 marrow reports independently, and bring these marrows to staff hematopathologist for final sign out.

MEDICAL EXPERT
1. To learn the principles of morphology of different hematological diseases in bone marrows and to identify metastasis in the marrows.
2. To be able to identify granulomatous disease, amyloidosis and Gaucher’s disease in bone marrows.
3. To learn about bone pathology, normal bone marrow biopsies and abnormal bone marrow biopsies.
4. To learn to identify metastatic disease in a marrow.
5. Shall produce reports on bone marrow smears, marrow biopsies and films from other body sites. Shall recognize significant abnormalities and record them. Shall make appropriate recommendations about further investigations.
6. To learn to identify bone pathology.
7. To consolidate expertise in the procedure for bone marrow aspirates and biopsies.
8. To achieve graded responsibility for peripheral blood film sign out, with goal of independent sign out by start of PGY3 year. To achieve this, on the 5th to 8th weeks of this rotation, the resident will review and write comments on all PB/body fluid slides independently, and then bring all slides to staff hematopathology for final sign out.

COMMUNICATOR / COLLABORATOR
1. To become proficient in writing clear reports to convey the important features to the receiving physician.
2. Demonstrate proficiency using LIS/powerpath for writing marrow reports.
3. To call ordering physician for preliminary results if urgency required
4. To communicate effectively and professional with laboratory staff for additional special testing on specimen

LEADER
1. Develops skill in working closely with laboratory technical staff

HEALTH CARE ADVOCATE
1. Makes selection of cases for further diagnostic testing
2. Responds positively to interpretive possibilities during the rotation to improve patient health

SCHOLAR
1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on a peripheral blood morphology topic. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL
1. Shall deliver the highest quality care by developing expertise in morphology
2. Shall respond promptly and helpfully to requests for assistance
3. Shall work effectively and collaboratively with laboratory staff
COMPETENCY CHARACTERISTICS
By the end of the rotation, the resident should:
1. Have refreshed skills in peripheral blood morphology
2. Be able to interpret all peripheral blood that are processed
3. Be able to interpret routine bone marrow aspirate and biopsies of common conditions

EVALUATION
1. Successful completion of the self-assessment cases (see recommended texts below).
2. Evaluation of seminar presentation.
3. Glass slide quiz

REFERENCE MATERIALS
Eight Weeks  Transfusion Medicine  Year 2

Dr. E. Saidenberg

OUTLINE

Monday  08:30  Program Director’s Rounds
         09:15  Hemepath Academic half day
Tuesday  08:00  Medicine Grand Rounds
Thursday 08:00  Leukemia/Lymphoma Rounds
         13:00  Thrombosis Rounds
Friday   11:30  OBDC Conference Room L2247
         12:00  Clinical Hematology Rounds
Weekly (Tuesday) 12:00  CBS Transfusion Medicine Residents Rounds (teleconference)
Monthly (Thursday) 12:00  U of T rounds (videoconference)

The following processes will be followed:
1. Knowledge mapping and pre-assessment
2. Rotation/training
3. Final examination
4. Clinical Case Reports (10)
5. Antibody Case Reports (10)
6. Topic Presentation (1)

There will be a self-administered pre-assessment of Transfusion Medicine knowledge and a short examination prior to the commencement of the rotation. From Monday to Friday, the resident will take daytime call for transfusion medicine and apheresis services. A final written examination and interview will complete the rotation.

1st Rotation  Six weeks in the hospital Transfusion Medicine laboratory

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>TOPIC</th>
<th>LAB COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Major Blood Groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1) ABH system</td>
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<tr>
<td></td>
<td>• Inheritance, Biochemistry, Subgroups</td>
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<td></td>
<td>• Antibodies</td>
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<td>• Grouping</td>
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<td>• Discrepancies</td>
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<td>2) Rh system</td>
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<td>• Inheritance</td>
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<td></td>
<td>• Nomenclature</td>
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<td></td>
<td>• Antibodies</td>
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<td></td>
<td>• Weak D- indications for investigation, management</td>
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<td></td>
<td>• Grouping</td>
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<td>• RhIg</td>
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<td></td>
<td>• Mechanism of action</td>
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<td>• Indications</td>
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<td></td>
<td>Group and Screen</td>
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<td></td>
<td>Crossmatch</td>
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<tr>
<td></td>
<td>Resolution of ABO discrepancies</td>
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<tr>
<td></td>
<td>Investigation of weak D phenotype</td>
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<tr>
<td></td>
<td>Quality issues in Transfusion Medicine</td>
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<tr>
<td></td>
<td>(Ms. Doris Neurath, Lab Manager)</td>
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<tr>
<td>PERIOD</td>
<td>TOPIC</td>
<td>LAB COMPONENT</td>
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<tr>
<td>Week 2</td>
<td>Transfusion reactions</td>
<td>The antiglobulin tests (IAT and DAT)</td>
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<td></td>
<td>• Pathophysiology</td>
<td>• Principle</td>
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<td></td>
<td>• Presentations</td>
<td>• Indications</td>
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<td></td>
<td>• Prevention</td>
<td>• Causes of false positives and negatives</td>
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<td></td>
<td>• Investigation</td>
<td>• Modifications of tests (i.e. enzymes, LISS, solid phase technology)</td>
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<td>• Management</td>
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<td></td>
<td>• Role of biovigilance programs</td>
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<tr>
<td>Week 3</td>
<td>Prenatal/ neonatal TM issues</td>
<td>Prenatal investigations</td>
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<td></td>
<td>• RBC allo-immunization and HDN</td>
<td>• Kleihauer test, rosette test</td>
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<td></td>
<td>■ Pathophysiology</td>
<td>• Platelet antigen testing</td>
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<td>■ Diagnosis</td>
<td>• HPA nomenclature</td>
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<td>■ Treatment</td>
<td>• ELISA-based assays</td>
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<td>• Neonatal Alloimmune Thrombocytopenia</td>
<td>• MAIPA and other tests</td>
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<tr>
<td></td>
<td>■ Pathophysiology</td>
<td>• NAIT investigations</td>
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<tr>
<td></td>
<td>■ Diagnosis</td>
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<td>■ Treatment</td>
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<tr>
<td>Week 4</td>
<td>Immune hemolytic anemias</td>
<td>Antibody investigations</td>
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<td>• Warm, cold, drug-induced, PCH</td>
<td>• Develop practical approach</td>
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<td>• Pathophysiology</td>
<td>• Interpret panels</td>
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<td></td>
<td>• Blood bank investigations</td>
<td>• Special procedures (i.e. phenotyping, absorption, enzymes)</td>
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<td></td>
<td>• Transfusion indications and issues</td>
<td>■ Indications</td>
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<td></td>
<td>■ Interpretation</td>
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<tr>
<td>Week 5</td>
<td>Transfusions in special populations</td>
<td>Investigations for management of platelet refractoriness</td>
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<tr>
<td></td>
<td>• Neonates and children</td>
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<td>• Transplant recipients</td>
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<td>■ Solid organs</td>
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<td>■ BMT</td>
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<td>• ABO-mismatched BMT</td>
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<td>• Platelet refractoriness</td>
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<td>• Alloimmunized patients</td>
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<td>Rare blood types</td>
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<tr>
<td>Week 6</td>
<td>Trauma and massive transfusion</td>
<td>Procedures for emergency release of blood products</td>
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<tr>
<td></td>
<td>• Management of massive hemorrhage</td>
<td>• Massive transfusion algorithm</td>
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<td>• Use of adjunctive hemostatic agents</td>
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<td>Prevention, recognition and management of</td>
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<td>complications of massive transfusion</td>
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<td>Learn the principles of blood conservation</td>
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<td>pre, during and post surgery.</td>
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<td>Meet with Mrs. Donna Touchie, RN</td>
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</table>
2nd Rotation  Two weeks at the Canadian Blood Services – Ottawa Centre

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>TOPIC</th>
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</table>
| Week 7/8 | Blood components  
• Understand role of CBS in blood collection and management  
  ▪ Donor clinic operations and planning  
  ▪ Donor recruitment  
  ▪ Whole Blood  
  ▪ Plateletpheresis  
  ▪ Donor testing  
  ▪ Principles of testing  
  ▪ Lookback/traceback investigations  
• Knowledge of all available products for transfusion  
  ▪ Preparation  
  ▪ Storage  
  ▪ Evidence-based Indications for use |

OBJECTIVES

The resident will:

4. Develop consultation skills for blood component therapy and adverse reactions to blood/components, applying an understanding of the genetics and immunology of blood groups/antibodies to patient problems
5. Learn to supervise the proper quality control of blood/components for transfusion
6. Be able to recommend blood/components appropriate to the clinical circumstances
7. Be knowledgeable in the appropriate pre-transfusion tests used to prevent transfusion-transmitted diseases and unexpected adverse reactions to transfusion.
8. Learn to direct the investigation of serological transfusion reactions and make recommendations for the prevention and management of adverse events
9. Learn good communication skills for explaining and directing transfusion medicine operations/requirements
10. Develop organizational skills in relation to transfusion medicine laboratory activities and staffing including: component storage/monitoring, directing routine serological testing/investigations in timely manner and QC of reagents/equipment
11. Participate in the teaching of medical/nursing staff and presentation of transfusion medicine material at rounds and other meetings.
12. Learn to apply current transfusion medicine literature to clinical problems
13. Be able to act as a consultant in the qualification, acceptance or rejection of questionable donors
14. Be able to explain donor recruitment and adverse reactions to donations and understand the importance of pre-donation screening to prevent transfusion-transmitted diseases and unexpected adverse reactions to transfusion
15. Learn the risks/benefits of autologous donation and other alternatives to allogeneic blood transfusion
16. Develop an approach for the assessment of recent proficiency testing results for the TM lab
<table>
<thead>
<tr>
<th>ROLES</th>
<th>OBJECTIVES</th>
<th>STRATEGIES</th>
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</thead>
<tbody>
<tr>
<td>Medical Expert, Clinical Decision Maker</td>
<td>Learn basic serological testing and interpretation</td>
<td>• Participate in daily blood bank activities</td>
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<tr>
<td></td>
<td>1. ABO &amp; Rh blood group systems</td>
<td>• Prepare weekly presentations</td>
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<tr>
<td></td>
<td>2. Inheritance and development of red cell antigens</td>
<td>• Participate in educational activities such as teleconferences and videoconferences</td>
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<td>3. Occurrence, structure, development and Ig class of antibodies</td>
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<td>4. Atypical and autoantibodies</td>
<td>• Spend time at a Canadian Blood Services collection centre and processing facility</td>
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<td>5. Mechanism of red cell destruction</td>
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<td>6. Mechanism of hemolytic transfusion reactions and hemolytic disease of the newborn</td>
<td>• Investigate transfusion reactions that are reported within the hospital and complete PHAC Transfusion Adverse Events Reporting forms</td>
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<td>7. Other blood group systems, e.g., MNSs, P, ii, Kk, Jk, Le, Lu</td>
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<td>8. Prenatal and postnatal testing</td>
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<td>9. Diagnosis and investigation of various forms of adverse reactions to blood/product transfusions</td>
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<td>10. Pre-transfusion testing (crossmatch)</td>
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<td>Learn specialty serological skills</td>
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<td></td>
<td>1. Explain technical skills relevant to blood group serology</td>
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<td>2. Understand appropriate investigative tools to resolve discrepancies</td>
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<td>3. Elicit/retrieve history that is relevant, concise, accurate and appropriate to a patient’s problem</td>
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<td>4. Review data collected as a means towards solving a patient’s problem</td>
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<td>ROLES</td>
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<td>5.</td>
<td>Develop effective consulting skills in preparing and presenting recommendations in written or verbal form, in response to requests from another healthcare provider</td>
<td>Learn consultation/interpretive skills</td>
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<tr>
<td>6.</td>
<td>Access and retrieve patient information through the laboratory computer information system</td>
<td>1. Identify the indications/contra-indications for transfusion therapy and the choice of appropriate products for transfusion</td>
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<td>2. Identify the appropriate course of action in the event of an incompatible cross match</td>
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<td>3. Identify the role for autologous, directed and designated blood transfusion</td>
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<td>4. Identify the availability, source and indications for: platelets, granulocytes and rare blood types</td>
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<td>5. Identify appropriate investigation and actions for various types of transfusion reactions, in particular Hemolytic transfusion reaction</td>
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<td>6. Identify the appropriate course of action for hemolytic disease of the newborn</td>
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<td>7. Knowledge of medico-legal issues associated with blood transfusion</td>
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<tr>
<td>ROLES</td>
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</table>
|       | Develop an understanding of blood donor recruitment, selection, donation process and donor testing | 1. Donor history  
2. Physical examination – relevant & appropriate  
3. Laboratory screening tests – appropriate for donor type  
4. Interpretation of test results  
5. Communication – written & verbal with donors, including positive TD results, LB/TB  
6. Database – access and retrieve pertinent donor information  
7. Understand the medico-legal issues associated with blood donation |
|       | Learn processing, storage and distribution of blood products | 1. Manufacturing of blood products  
2. Describe fractionation process  
3. Understand relevance of GMP  
4. Appropriate storage for blood products  
5. Appropriate distribution of blood products |
<table>
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<tr>
<th>ROLES</th>
<th>OBJECTIVES</th>
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<tbody>
<tr>
<td>Communicator</td>
<td>Develop skills for productive interaction with technologists and technicians in blood bank</td>
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<td>Develop skills to communicate effectively with clinicians whose patients have transfusion issues</td>
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<td>Develop skills for communication with blood donors who have questions regarding notification of test results</td>
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<td>Develop skills for communication with blood donors and recipients involved in lookback and traceback investigations</td>
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<td>Recognize the importance of donor anonymity and patient confidentiality</td>
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<td>Collaborator</td>
<td>During this rotation consult and collaborate with other healthcare workers to help ensure safe and timely resolution of transfusion issues</td>
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<td>Contribute to interdisciplinary team activities, rounds, etc.</td>
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<td>Participate in transfusion medicine committees/group meetings when available</td>
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<tr>
<td>ROLES</td>
<td>OBJECTIVES</td>
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</table>
| Leader       | 1. Utilize time and resources effectively  
2. Develop efficient organization skills to ensure accurate identification and controlling of specimens and reports  
3. Demonstrate the accurate techniques for labeling and issuing of blood, (matched and unmatched)  
4. Develop an understanding of the required elements for maintenance and control of equipment, in particular refrigerators/freezers used to store blood/products |                                                                                                                                            |
| Professional | 1. Demonstrate appropriate personal and interpersonal behaviors  
2. Within the resident’s level of understanding, deliver the highest quality care with integrity, honesty and compassion  
3. Work in an ethically responsible manner that respects the medico-legal aspects of transfusion medicine |                                                                                                                                            |
| Health Advocate | Understand the controversies surrounding transfusion triggers in various clinical settings and become an advocate for appropriate transfusion practice and blood conservation  
Understand the formative role of the Kreever Commission in the history of transfusion medicine in Canada | Participation in inter-disciplinary events designed to increase awareness of safe and appropriate transfusion practices  
Investigate unusual blood product requests to ensure that patient needs are being met in the safest manner |
Scholar | Develop a familiarity with the medical literature pertaining to transfusion medicine | Presentations should include evidence for transfusion practice recommendations and should also explore evidence in areas where controversy exists

### COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:

1. Learned all basic serological testing and interpretation, specialty serological skills, consultation/interpretive skills in Transfusion Medicine for implementation within the hospital
2. Learned the criteria for blood donor selection, testing of donated blood and the processing, storage and distribution of blood products at the Blood Centre

### EVALUATION

1. Evaluation of weekly seminar presentations and written projects.

### SUGGESTED READING

1. Transfusion
2. Vox Sanguinis
3. AABB Standards, CSA Standards
4. All articles on the USB key are considered required reading.
OBJECTIVES

The evaluation of patients with hemorrhagic or thrombotic complications is a stepwise process involving the clinical history, physical examination and a rational series of laboratory testing. Skills required by the coagulation consultant start with the patient evaluation, extend into the diagnostic laboratory and come full circle to the patient with recommendations for therapy. Hematopathologists play a vital role in this process by enabling accurate and timely laboratory investigations which are appropriately reported to clinicians caring for patients with hemostatic and thrombotic conditions. To strengthen coagulation consultation skills, for the first 4 weeks of this rotation, the hematopathology resident will participate in bleeding disorder clinics, rounds and consults, as listed below.

Clinics.
- Tuesday afternoons, starting around 1:45pm, Module H. Hemophilia/hemostasis clinics, usually 3 or 4 Thursday afternoons per month.

Rounds/meetings.
- Resident to attend weekly hemostasis team meeting on Monday mornings from 11 – 12, conf room L2247.
- Resident to attend weekly Thrombosis rounds. Thursdays, 1 – 2pm, room L2247 conference room.

Consults.
- Resident to take daytime on call for hemostasis, participate in daytime clinical wards consults and follow hemostasis in-patients at the General Campus.

OUTLINE

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<tr>
<th>PERIOD</th>
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<th>LAB COMPONENT</th>
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</table>
| Week 1 | Overview of hemostasis | 5. Prothrombin time and Activated partial thromboplastin time and 50:50 mix  
6. Thrombin Time  
7. Fibrinogen  
8. D-Dimer (whole blood agglutination method and immuno-turbidimetric method)  
The above tests should be performed manually or observed at the Routine Coag bench. As well, the resident will learn the principles of how coagulation instruments work (weeks 1 – 3), and quality issues in the hemostasis lab. |
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<tr>
<th>PERIOD</th>
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<th>LAB COMPONENT</th>
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| Week 2 | Inherited deficiencies of clotting factors  
- Hemophilia A  
- Hemophilia B  
- Rare clotting factor deficiencies | 4. Factor assays  
5. Inhibitor detection by mixing studies and by Bethesda Unit method  
6. Genetic testing for inherited coagulation disorders  
The above tests will be performed manually by the resident. |
| Week 3 | Von Willebrand's Disease | 4. von Willebrand Factor Antigen  
5. Von Willebrand Multimers  
6. Ristocetin CoFactor |
| Week 4 | Platelet physiology  
Disorders of platelet number and function | 5. Platelet Aggregation & release  
6. Platelet electron microscopy  
7. Flow cytometry of platelets  
8. HIT investigations  
The above tests will be performed or observed by the resident using standard methodology. |
| Week 5 | Natural inhibitors of coagulation  
Lupus Anticoagulant | 7. Protein C  
a. Clottable  
b. Chromogenic  
c. Immunologic  
8. Protein S  
a. Functional  
b. Immunologic  
9. AT  
a. Functional  
b. Immunologic  
10. FV Leiden  
a. APCR  
b. Genetic  
11. PT gene mutation  
12. APLA  
a. Screening test  
b. Mixing tests  
c. Confirmatory tests  
d. ELISAs |
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<th>PERIOD</th>
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</table>
| Week 6 | Acquired coagulation disorders | 3. Molecular biology assays  
|        | Liver disease | 4. Western Blot assays  
|        | Vitamin K deficiency |  |
|        | DIC |  |
| Week 7 | The fibrinolytic system  
|        | Special hemostasis topics | 11. Plasminogen  
|        | | 12. α2-antiplasmin  
|        | | 13. Euglobulin clot lysis  
|        | | 14. D-dimer  
|        | | 15. FDP  
|        | | 16. TCT w/out CaCL1  
|        | | 17. Reptilase  
|        | | 18. Urea clot solubility  
|        | | 19. Immuno and chromogenic FXIII assays  
|        | | 20. Cryofibrinogens  |
| Week 8 | Acquired disorders of coagulation |  |
|        | Liver disease |  |
|        | Vitamin K deficiency |  |
|        | DIC |  |

Drs. Saidenberg, Tinmouth, Giulivi and Marisa Freedman MLT, ART
### ROLES

<table>
<thead>
<tr>
<th>Medical Expert</th>
<th>OBJECTIVES</th>
<th>STRATEGIES</th>
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<tbody>
<tr>
<td>The resident will demonstrate diagnostic and therapeutic skills for hemostatic or thrombophilic disorders. Areas of particular importance that will be covered in this rotation include technical aspects, quality issues in testing and clinical applications of the following conditions and diseases:</td>
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<tr>
<td>19. Hemostatic testing and laboratory interpretation.</td>
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<td>20. A systemic approach to the bleeding patient</td>
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<tr>
<td>21. Hemophilia A and B</td>
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<td>22. Other congenital disorders of hemostasis.</td>
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<td>23. Inhibitors of coagulation</td>
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<td>24. Von Willebrand Disease</td>
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<td>25. Disorders of Platelet Function</td>
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<td>26. Immune thrombocytopenic purpura</td>
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<td>27. Disseminated Intravascular Coagulation</td>
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<td>28. Inherited thrombophilias</td>
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<td>30. Prevention, diagnosis and treatment of postphlebitic syndrome.</td>
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<td>31. Thrombocytosis and thrombocytopenia</td>
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<td>32. Antiphospholipid syndrome</td>
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<td>33. Hemostatic and thrombotic disorders in malignancy</td>
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<td>34. Heparin induced thrombocytopenia</td>
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<td>35. Antithrombotic and thrombolytic agents</td>
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<tr>
<td>36. Transfusion medicine and hemostasis</td>
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<tr>
<td>19. Coagulation complications of pregnancy</td>
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• Observe and perform laboratory tests. |
• Prepare weekly presentations. |
• Assist with interpretation of laboratory tests.
### Eight Weeks Coagulation-Hemostasis Year 2

**Introduction**

Drs. Saidenberg, Tinmouth, Giulivi and Marisa Freedman MLT, ART

<table>
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<tr>
<th>ROLES</th>
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| Communicator| • Develop skills for productive interaction with technologists and technicians in the laboratory  
• Develop skills to communicate effectively with clinicians caring for patients with hemostatic/thrombotic conditions | • The resident will be encouraged and expected, on a one-to-one basis, to collaborate and communicate with the technical staff and the supervisor on a daily basis.  
• Communicate abnormal results to clinicians when indicated  
• Enhance presentation skills through weekly presentations |
| Collaborator| • During this rotation the resident will consult and collaborate with other health care workers regarding diagnostic and therapeutic issues related to hemostasis and thrombosis  
• Resident is expected to contribute to interdisciplinary team activities | • Provide verbal or formal consultation for physicians regarding clinical significance of test results and assist to develop a care plan for the patient.  
• Advise laboratory staff to initiate additional testing if required.  
• Recommend treatment options.  
• Present rounds on a clinical case to staff of special hematology laboratory |
| Leader      | • The resident will demonstrate proper selection, handling and preparation of specimens and controls for the methodologies current in the lab. The resident will analyze, prepare and sign out reports generated in the lab under supervision.  
• Overview of QA/QC procedures specific to the test procedures used. | 2. The resident will have discuss utilization of resources, budgetary considerations, and the utilization of new technology in weekly presentations as well as in person with laboratory staff, with the aim of developing managerial skills. |
## ROLES

### Scholar

<table>
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<tr>
<th>Objective</th>
<th>Strategies</th>
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<tbody>
<tr>
<td>1. Resident should recognize gaps in knowledge and develop strategies to fill gaps through self-directed learning and consultation with other members of the health care team.</td>
<td>• Schedule reading timetable and comply with schedules • Learn to effectively utilize tools such as Medline</td>
</tr>
<tr>
<td>1. Develop critical appraisal skills specific to the literature regarding blood coagulation and hemostasis.</td>
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### Professional

<table>
<thead>
<tr>
<th>Objective</th>
<th>Strategies</th>
</tr>
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<tbody>
<tr>
<td>• Understand the professional, legal and ethical codes to which physicians are bound.</td>
<td>• The resident should recognize his or her own limitations and ask for advice when needed • Respond appropriately to constructive feedback</td>
</tr>
<tr>
<td>• Provide appropriate follow up to abnormal test results and order additional testing as appropriate.</td>
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### Health Advocate

<table>
<thead>
<tr>
<th>Objective</th>
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<tr>
<td>• Advocate for improved access to diagnostic services.</td>
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</table>

## COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:

1. Knowledge of the principles and procedures of various coagulation methods.
2. Knowledge of specimen requirements and handling for various tests currently in use in the lab.
3. An understanding of how various coagulation methods are applied to clinical medicine.
4. An understanding of what information is required by the clinicians and be able to independently interpret the results generated in the lab.
5. Develop an approach for the assessment of recent proficiency testing results for the coagulation lab, including understanding of precision, accuracy and allowable performance limits.

## EVALUATION

Regular topic presentations. Residents to complete 10 case report forms. Resident's ability to correctly interpret lab results will be assessed during routine results interpretation sessions.
REFERENCE MATERIALS

1. Binder with objectives and reading material for the rotation is available from the supervisor.
2. Handouts covering main topics will be provided: publications & powerpoint presentations.
3. Additional references and reading material available from the supervisor.
4. Articles on USB key provided are considered required reading.

Recommended Text books:


OUTLINE

Monday  09:00  Autopsy Rounds, if hematologic cases
       11:00  Attends pathology case presentation if hematologic
Thursday 08:00  Lymphoma Rounds
Thursday 14:00  Hematology Grand Rounds (if applicable)
Thursday 15:30  Morphology Rounds
Friday   12:00  Clinical Hematology Rounds

SPECIFIC OBJECTIVES

At the completion of training, the resident will have acquired the following competencies and will function effectively as:

MEDICAL EXPERT/CLINICAL DECISION-MAKER

General Requirements
1. To develop an algorithmic approach to diagnosis of lymphoproliferative disorders in a variety of organs based on histology and immunophenotype
2. Access and apply relevant information to clinical practice.
3. To develop a working knowledge of basic histology
4. To develop a working knowledge of WHO lymphoma classification

Specific Requirements
1. Demonstrate knowledge of normal anatomy, physiology and immunology of the lymphatic/immune system.
2. Demonstrate understanding of the general principles of embryologic development and the commoner variations of normal lymph nodes, spleen, thymus and bone marrow.
3. Demonstrate a superior and detailed knowledge of the normal gross and light microscopic appearance of lymph nodes, spleen and other lymphoid tissues.
4. Understand the basic principles of cell biology, immunology and pathogenesis, and the changes that occur in specific lymphomas.
5. Be familiar with the CD classification of lymphocyte antigens and their application to immunophenotyping of lymphoproliferative disorders.
6. Understand the principles of immunohistochemical diagnosis in malignant and inflammatory conditions.
7. Understand the principles of tissue processing and the use of different fixatives in the laboratory.
8. Demonstrate an in-depth knowledge of the appropriate processing and sampling of biopsy specimens for suspected lymphoma.
9. Understand the principles of nucleic acid-based molecular biology techniques and be familiar with their application to diagnosis in lymphoma diagnosis, especially the role of PCR and Southern blotting in gene rearrangement, lineage and specific translocation studies.

10. Understand the overall approach to examining a lymphoid organ microscopically, formulating a differential diagnosis based on histologic features and proceeding with the selection of confirmatory immunophenotyping.

11. Be familiar with the WHO classification of lymphoproliferative disorders and their clinical significance.

12. Understand the diagnostic pitfalls in interpreting biopsy tissues, including sample size, fixation problems, etc.

13. Demonstrate ability to take satisfactory gross and microscopic photographs of lymphoid tissues, including digital presentations of individual cases for teaching purposes.

14. Demonstrate working knowledge of basic histology.

COMMUNICATOR

General Requirements
1. Discuss cases with other members of the health care team in terms of diagnosis and prognosis.

Specific Requirements
1. Assist in the continuing education of physicians and other members of the hospital staff by participating in educational/clinical review forums such as lymphoma rounds.
2. Act as consultants to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
3. Understand the information a pathology report should provide in a given clinical situation and be able to communicate it effectively in an oral and written form.

COLLABORATOR

General Requirements
1. Consult effectively with other physicians and health care professionals.
2. Contribute effectively to other interdisciplinary team activities.
3. Understand the role of the pathologist as “gate-keeper” in patients entering clinical trials

Specific Requirements
1. Must have experience in clinical medicine and surgery sufficient to achieve a sound understanding of the effects of disease and the role of pathology in its management.
2. Demonstrate the ability to advise on the appropriateness of obtaining histologic and cytologic specimens and following examination of these, to advise on further appropriate investigations.
LEADER

**General Requirements**

1. Utilize resources of the pathology laboratory effectively to achieve an accurate diagnosis.
2. Allocate finite health care resources wisely.
3. Work effectively and efficiently in a health care organization.
4. Utilize information technology to optimize patient care, life-long learning and other activities.

**Specific Requirements**

1. Demonstrate knowledge of the methods of quality control in the laboratory as it relates to flow cytometry and immunohistochemistry of lymphoproliferative disorders.

HEALTH CARE ADVOCATE

**General Requirements**

1. Identify the important determinants of lymphoma pathogenesis and diagnosis.

**Specific Requirements**

1. As members of an interdisciplinary team of professionals responsible for individual and population health care, the anatomical pathologist will endeavour to help in informing the public about issues surrounding the diagnosis of lymphomas and risk factors for their development.

SCHOLAR

**General Requirements**

1. Develop, implement and monitor a personal continuing education strategy with respect to continuing education in lymphoma pathology.
2. Critically appraise sources of medical information and recognize the current best sources for lymphoma research reporting.
3. Facilitate learning of patients, house staff/students and other health professionals at rounds.
4. Contribute to development of new knowledge.

**Specific Requirements**

A small research project or case report should be discussed with the rotation supervisor at the beginning of the elective. This could be presented at any one of a number of forums ranging from lymphoma rounds to national meetings.
PROFESSIONAL

General Requirements

1. Deliver highest quality care with integrity, honesty and compassion.
2. Exhibit appropriate personal and interpersonal professional behaviours.
3. Practice medicine ethically consistent with obligations of a physician.
4. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

1. Act as an appropriate role model for students and others.
2. Demonstrate a professional attitude to colleagues, as well as to other laboratory staff.
3. Have an appreciation of the crucial role of the anatomical pathologist in providing quality patient care. This will include knowledge of individual professional limitations and the necessity of seeking appropriate second opinions.

KNOWLEDGE

1. Shall recognize tumors of lymphoid tissue and the main reactive condition of lymph nodes. Produce reports of these and signs them out with staff pathologist.
2. Correlates flow cytometry and DNA studies with morphologic findings and produces clinically relevant reports.

Assessment:

1. Review of slide box of basic histology (from Dr. Jason Wasserman)
2. Read book Chapters and complete of study questions form e-Study Guide of Histology for Pathologists, Chapter 3 Breast, Chapter 11 Central Nervous system, Chapter 19 Thymus, Chapter 32 Spleen.

References:

3. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues; 4th Edition; 2008
The hemoglobinopathy rotation will be done both at CHEO and at The Ottawa Hospital, General Campus. Both laboratories perform hemoglobinopathy investigations, but the patient population is quite different at each site; residents will benefit from reviewing cases from both sites. The resident will coordinate with Drs. Leung, Saidenberg and Marisa Freedman how best to divide their time between CHEO and The Ottawa Hospital, General Campus, to obtain the most benefit from this rotation. The trainee is expected to interpret all the haemoglobinopathy gel runs and review results with staff hematopathologists. The resident is expected to prepare a rounds presentation during the rotation. The resident will meet with Dr. Padmore at the end of weeks one, two and three, to go over the review questions from the textbook by Barbara Bain: “Haemoglobinopathy Diagnosis” and to review recent proficiency testing results.

**WEEKLY SCHEDULE / OBJECTIVES**

**Week One**

**Introduction to Hemoglobinopathies**

- Review videos and teaching slides on the morphology of the hemoglobinopathies.
- Review structure of hemoglobin: heme moiety, globin chains
- Review genetics of hemoglobin: α gene cluster and β gene cluster
- Review expression of Hb (Gower, Portland, Fetal) in utero and in adult (Hb A, Hb A2)
- Review inheritance of Hb (autosomal co-dominant)
- Observe preparation of hemolysate and observe running of high performance liquid chromatography (HPLC) and/or alkaline/acid electrophoresis and/or isoelectric focusing gels
- Review Hb separation methods:
  - Gel electrophoresis: alkaline, acid, isoelectric focusing
  - High performance liquid chromatography (HPLC)
  - Capillary gel electrophoresis
- Become familiar with gel electrophoresis and learn to interpret alkaline, acid and isoelectric focusing gels
- Become familiar with HPLC methodology and technology. Learn to interpret HPLC chromatograms
- Become familiar with capillary gel electrophoresis method and technology. Learn to interpret capillary gel electrophoresis results
- Be able to interpret laboratory results performed on patients from a range of ages. Be aware of normal age related changes in Hb percentages.
- Understand quality issues in hemoglobinopathy diagnostics


**Required Review Questions to Complete:** Review Questions at the end of Chapters 1 and 2, Bain, Barbara J. Haemoglobinopathy Diagnosis. 2nd edition. 2006. Blackwell Publishing, and meet with Dr. Padmore to review answers at end of Week One.
Week Two

The thalassemia syndromes
(α thalassemia, β thalassemia,)
- Review pathophysiology of low MCV, and lab test methods used to distinguish between iron deficiency, anemia of chronic disease and thalassemia syndromes
- Review diagnostic tests for thalassemia syndromes:
  - Hb A2 and F quantitation
  - Hb H inclusions
  - DNA methodologies: PCR, Southern blot, direct sequencing of beta globin gene
- Review slides and gels/HPLC of thalassemia cases (minor, major, hydrops fetalis)
- Review Hb H inclusion morphology, distinguish from artifact and reticulocytes

Required reading:

Week Three  Sickle cell disease and Other Variant Haemoglobins

- Observe the performance of the sickle solubility test
- Review reasons for false positives and false negatives with the sickle solubility test
- Review location of sickle band on alkaline gel, acid gel, isoelectric gel, HPLC, and recognize other Hb that may co-migrate
- Understand the significance of Hb S interactions with other Hb variants and thalassemic states: e.g. Hb S/β thal, Hb S/C disease, HbS/HPFH.
- Review the peripheral blood morphology of the compound heterozygous states
- Understand the effect of concurrent thalassemia syndromes on the % Hb S in compound heterozygote states
- Recognize that the sickling disorders impact on other areas in laboratory medicine, including routine haematology and transfusion medicine.
- Be familiar with the current standards of clinical care for the sickling disorders.
- Be familiar with the more common Hb Variants (Hb C, D, E, and O-Arab) and their clinical manifestations.

**Required reading:**

Week Four Screening methods and aims
Review algorithms for screening in the following circumstances:
• Prenatal/Antenatal
• Neonatal – become familiar with the Ontario Newborn Screening Program and their mandate for the detection of clinically significant sickling disorders.
• Lab generated, low MCV testing
• Review methodology for fetal hemoglobin testing: Immunodiffusion, Keihauer-Betke, flow cytometry
• Perform calculation for fetal Hb using Kleihauer assay
• Review low MCV cases in lab for checking that week and select cases for further haemoglobinopathy investigation.

Required reading:

Required Review: Do exit test and review results with staff supervisor

OBJECTIVES

MEDICAL EXPERT
1. To understand the physiology of the hemoglobin molecule
2. To understand the underlying pathophysiology of thalassemias and variant haemoglobins.
3. To learn to recognize hemoglobinopathies from peripheral blood indices and morphology.
4. To learn and practice the various laboratory techniques used to diagnose the hemoglobinopathies.
5. To have a basic understanding of the molecular technologies used in the diagnosis of the haemoglobinopathies.
6. To learn the specifics of hemoglobin electrophoresis, HPLC and isoelectric focusing.
7. To understand the clinical implications of the haemoglobinopathies.
8. To have a good understanding of the current management of the sickling disorders, including transfusion related implications.
9. To have an organized approach to the diagnosis and investigation of the haemoglobinopathies as outlined in recent practice guidelines.
10. Assessment of recent proficiency testing results for the hemoglobinopathy lab, including understanding of precision, accuracy and allowable performance limits
COMMUNICATOR
1. Learns to review and report all haemoglobinopathy investigations.
2. Demonstrates through formal rounds that there is an increasing proficiency in the diagnosis of the hemoglobinopathies.
3. To be able to convey relevant information to clinical team members regarding significant haemoglobinopathy disorders and to guide any further investigations as needed.
4. To learn how to write meaningful interpretations and reports.

COLLABORATOR
1. Learns to review low MCV cases in lab, to consult with other laboratory medicine specialists and to select cases for further investigation.

LEADER
1. Develops skill in working closely with laboratory technical staff.

HEALTH CARE ADVOCATE
1. Makes selection of cases for further diagnostic testing.
2. Responds positively to interpretive possibilities during the rotation to improve patient health.
3. Understands the principles behind antenatal and neonatal screening programs and how they can be used to promote public health.

SCHOLAR
1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on hemoglobinopathies. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL
1. Shall deliver the highest quality care by developing expertise in Hemoglobinopathies.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.
COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:

1. Have increased skills in hemoglobinopathies.
2. Be able to interpret haemoglobinopathy investigations meaningfully.
3. Be able to triage laboratory testing for the haemoglobinopathies appropriately and to suggest further testing as needed.

EVALUATION

1. Successful completion of the self-assessment cases and completion of the review questions as required.
2. Evaluation of seminar presentation.
3. Evaluation of the trainee’s ability to synthesize relevant laboratory data in the interpretation of results will be done throughout the rotation, as the trainee is expected to interpret each sample that is run.
3. A short exit exam may be administered.

REFERENCE MATERIALS

Recommended texts/readings:

OBJECTIVES

Molecular diagnostic assays are important tools in the investigation of disease. Molecular assays remain complex and require specialized staffing and equipment.

The overall goal of the first two weeks of this rotation is to introduce the resident to Molecular Diagnostics including how to safely handle tissue samples for molecular analysis. The resident will learn basic techniques at the laboratory bench, and to learn how to analyze results critically, including an appreciation of the limitations of each technique. The overall goal of the second two weeks is to learn how molecular diagnostics are used for the diagnosis and prognostication of hematological neoplasms.

Training is provided by didactic lecture, by hands-on bench experience, and in data review conferences. The resident is expected to have a background of basic cellular biology including a detailed understanding of DNA replication, transcription and regulation of transcription. The resident should understand the different types of DNA replication errors and mutations that can occur and how best to study these mutations.

Clinical Component: The resident is expected to critically appraise assays in the following areas: clinical utility, feasibility of implementation and quality control/quality assurance. The resident should also be able to identify assays which should be restricted to specific services; this includes assays where genetic counseling is indicated. The resident will understand how molecular results aid in the diagnosis and prognostication of hematological neoplasms, and how this information impacts patient care.

Clinical/Pathological Meetings for residents to attend:
1. The residents will attend the Leukemia Program Meeting, where patient’s molecular results are discussed. The Leukemia Program meetings occur every 3rd Wednesday of each month.
MEDICAL EXPERT

The resident will be able to describe and discuss the molecular mechanisms resulting in:
- Somatic mutation
- Loss of Heterozygosity

The techniques used in direct and indirect genetic diagnostic testing including:
- DNA extraction
- PCR amplification (fluorescent PCR) with Restriction enzyme digestion/ RFLP analysis for prothrombotic gene mutations: Factor V-Leiden (Factor V gene mutation-G1691A), Prothrombin gene mutation G20210A and Hemochromatosis gene mutations (HFE gene mutations)
- Sanger sequencing
- Next-generation sequencing
- Southern blot analysis
- Multiplex ligation probe amplification (MLPA)

The resident will demonstrate an understanding of:
- The indications, contraindications, limitations, sensitivities and specificities of various molecular technologies
- The appropriate methodologies for molecular testing in a given patient situation
- The principles of molecular mutation nomenclature
- Databases used in molecular diagnostics
- The nature, prognosis and treatment of conditions currently assessed by molecular genetic technologies
- Recommendations for additional molecular genetic investigations to clarify the etiology and prognosis of various neoplastic disorders
- The basic techniques of nucleic acid handling, including proper storage of tissue samples and the extraction of DNA from tissue, blood samples and paraffin-embedded tissues
- The electrophoresis methods for analysis of DNA, including agarose gel electrophoresis and capillary electrophoresis
- How to identify trinucleotide repeat expansions/contractions and understand how this analysis applies to the investigation of microsatellite instability
- How to digest DNA using restriction endonucleases and how restriction fragment length polymorphisms analysis can be used for targeted mutation detection
- How to detect genomic deletions and gains using appropriate technology and how these molecular and cytogenetic techniques compliment each other
- How to assess heterozygosity of polymorphic loci and how this applies to analysis of “loss of heterozygosity” in neoplasias
- How to select appropriate controls for molecular based assays
- How to analyze and interpret sequencing data

The resident will demonstrate the ability to:
- Interpret and report cytogenetic and molecular test results using standard nomenclature

COMMUNICATOR

The resident will demonstrate the ability to:
- Effectively communicate at a level appropriate to referring clinicians and other health care professionals the indications for, methodologies used in, and results of, a variety of molecular pathology tests, including any related uncertainties
- Provide the referring clinician with an understandable written summary of the result
- Communicate effectively with the members of the molecular laboratory, including the laboratory director, technologists and support staff

COLLABORATOR

The resident will demonstrate the ability to:
- Respect and consult effectively with the clinical laboratory director, technologists, and support staff to provide optimum patient care
- Where appropriate, be able to assume a leadership role in team settings
- Consult and work cooperatively with research scientists and other disciplines, where applicable, to advance knowledge of molecular pathology and patient care
- Recognize the importance of collaboration between Hematology Laboratory and Molecular Laboratory for establishing appropriate samples for molecular testing

LEADER

The resident will demonstrate the ability to:
- Allocate molecular diagnostic test resources wisely
- Utilize information technology to optimize interpretation of test results
- Utilize resources effectively to balance laboratory and learning needs
- Balance personal and professional demands on activities of daily living
- Promote quality assurance as it relates to laboratory results
- Maintain complete and accurate laboratory records

**HEALTH ADVOCATE**

The resident will be able to describe and discuss:
- How health care governance influences resource allocation for molecular laboratory testing at a local, provincial, regional, and national level
- The roles of national and international agencies in the determination of guidelines for molecular testing

The resident will demonstrate the ability to:
- Recognize and respond to those issues where advocacy for molecular testing is appropriate
- Refer molecular test inquiries to the appropriate laboratory, community and national resources

**SCHOLAR**

The resident will demonstrate the ability to:
- Use case encounters as a stimulus to further reading and review of the current literature
- Critically assess the molecular diagnostics literature, applying epidemiological and biostatistical principles where relevant
- Develop, implement and monitor a personal continuing education strategy.
- Apply and enhance teaching skills in the education of medical students, other residents and other health care professionals about molecular tests

**PROFESSIONAL**

The resident will demonstrate the ability to:
- Recognize the limitations of their expertise and skills and seek help whenever indicated
- Recognize his/her own cultural biases that may influence or impede ethical decision-making
- Recognize and demonstrate his/her obligation to effective teaching
- Understand, recognize and respect the role of molecular diagnostics staff including technologists, support staff and researchers.
- Display personal and professional attitudes consistent with a consulting physician
- Understand the duty of confidentiality and the difficulties it can pose in the interpretation and reporting of molecular diagnostic test results
MEDICAL EXPERT

The resident will understand the genetic defect, method of detection, and use of molecular testing for the following:

1. Leukemia/lymphoma molecular diagnostic/prognostic markers (B and T Cell Gene Rearrangement FR1,2,3, TCR rearrangement, and various translocations: IgH- BCL1-IgH, BCL2-IgH, IgH-BCL6, BCR-ABL, PML-RARA, AML-ETO, BCFB-MYH11, MLL-AF4, E2A-PBX1, TEL-AML1, API2-MLT, cMYC-IgH), and mutations: NPM1, BRAF, cKIT, PDGFRA, PDGFRB, FGFR1, MYD88.
2. Methylenetetrahydrofolate reductase gene mutation - MTHFR C677T
3. Ankylosing spondylitis and HLA-B*27
4. Microsatellite instability and chromosomal instability in cancer
5. Mitochondrial DNA mutations in Mitochondrial diseases

The resident will have understanding of the theory behind less common and less commonly used molecular techniques including:

- Pyrosequencing for SNPs
- Genomic and expression microarray analysis
- Molecular beacons and Scorpion primer
- and reverse transcription PCR (RT-PCR)
- PCR-SSP
- Nucleic acid sequence based amplification (NASBA)

COMMUNICATOR

1. The resident will be encouraged and expected, on a one-to-one basis, to collaborate and communicate with the technical staff and the supervisor on a daily basis.
2. Seminar and/or didactic discussion on topics related to this rotation.
COLLABORATOR

1. Consult with physicians regarding clinical significance of findings.
2. Interact with other laboratory staff to initiate additional testing if required.

LEADER

1. The resident will learn proper selection, handling and preparation of specimens and controls for the methodologies current in the lab. The resident will review reports generated in the lab under supervision.

2. The resident will have opportunity to discuss utilization of resources, budgetary considerations, and the utilization of new technology with the aim of developing managerial skills.
3. Overview of QA/QC procedures specific to the test procedures used.

SCHOLAR

1. Will be able to critically appraise data.
2. Will contribute to learning by presenting seminars related to DNA diagnostics.

COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:
1. knowledge of the principles and procedures of various molecular methods.
2. knowledge of specimen requirements and handling for various tests currently in use in the lab.
3. an understanding of how various molecular methods are applied to clinical medicine.
4. an understanding of what information is required by the clinicians and how to interpret the results generated in the lab.

EVALUATION

Oral and/or written examination/seminar
REFERENCE MATERIALS

- Binder with objectives and reading material for the rotation is available from the supervisor
- Handouts covering main topics will be provided: publications & powerpoint presentations
- Additional references and reading material available from the supervisor

Online resources:
PCR basic
https://www.youtube.com/watch?v=SvWyz7fcUCY&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl&index=4
https://www.youtube.com/watch?v=eEcy9k_KsDI&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl

Q PCR
https://www.youtube.com/watch?v=Ot7SyAxWnrY&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl

https://www.youtube.com/watch?v=yXj0jY9HeUY&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl&index=5

Q PCR data analysis:
https://www.youtube.com/watch?v=GQOnX1-SUrl&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl

https://www.youtube.com/watch?v=tgp4bbnj-ng&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl

Sequencing:
https://www.youtube.com/watch?v=bEFLBf5WEtc&list=PLPTKWal5wM75-gHv0x0JxNnGWJitGHIbl
Stanford Open Curriculum in Genomic Medicine
http://www.youtube.com/playlist?list=PLfTjR5bxMcTg8hqQp9sA4YQwicpSAQv
1. Methods for manipulating RNA and DNA
2. Fundamentals of human genetic variation
3. Microarrays and analysis of hybridization data
4. DNA sequencing including high-throughput sequencing (HTS)
5. Inherited genetic disorders
6. Acquired mutations in solid tumours (cancers)
7. Pharmacogenomics
8. HLA genetics
9. Acquired mutations in hematopoietic malignancies
10. Personal Genomics, commercial, regulatory and ethical considerations

Current Articles:
OBJECTIVES

Flow cytometry is an important diagnostic tool in the investigation of hematological disorders. While the methodology is relatively straightforward, the technical aspects may be challenging, and the interpretation of results, complex.

The 1\textsuperscript{st} year resident is new to hematopathology. The aim of this rotation is to provide a basic understanding of flow cytometry in the diagnosis of hematological malignancies. The resident also becomes aware of other diagnostic applications of flow cytometry in hematology, including in the assessment of bleeding disorders, fetal/maternal hemorrhage, and immune dysfunction.

The primary emphasis in this rotation is on the development of the resident as \textit{medical expert}. The diagnostic information provided by the technique of flow cytometry is often critical to patient management. During this 1\textsuperscript{st} year rotation, the resident will be trained in the interpretation of flow cytometric data, and shall become acquainted with common diagnoses. Other aspects of medical expert particularly germane to this rotation are the role of the specialist as \textit{communicator} (understanding the importance of conveying the interpretation in a timely fashion to clinicians), and \textit{leader} (allocating finite health resources wisely, understanding the concept triaging cases for flow cytometry including appropriately cancelling cases when not indicated, and using abbreviated panels if possible), and \textit{scholar} (in keeping abreast of recent advances in the field of flow cytometry).

ROUNDS

The resident is expected attend leukemia/lymphoma rounds on Tuesday morning 8am, when these rounds are directed to case presentations or other topics relevant to flow cytometry.

MEDICAL EXPERT

1. Shall understand the basic principles and practice of flow cytometry, and be able formulate an approach to trouble shoot basic technical problems.
2. Shall recognize neoplastic and non-neoplastic conditions of the hematolymphoid system where flow cytometry is diagnostically useful.
3. To be able to distinguish between B-cell chronic lymphocytic leukemia vs. mantle cell lymphoma, based on flow cytometry immunophenotyping (B-CLL is CD5+, CD23+, mantle cell lymphoma is CD5+, CD23-).
4. To be able to distinguish the lineage of acute leukemia (AML positive for myeloperoxidase, T-ALL positive for CD3, B-ALL positive for CD19)
COMMUNICATOR

1. Develops expertise in writing succinct flow cytometric reports, which are clear, accurate and appropriate and timely.
2. Participates in conversations with clinicians regarding the significance of the immunophenotypic markers and their diagnostic application.
3. Consults with clinical colleagues about problems of flow cytometric interpretation.

COLLABORATOR

1. Consults with other laboratory medicine specialists to obtain other relevant diagnostic tests (e.g. special stains, PCR).
2. Consults with clinical colleagues to suggest when flow cytometric analysis might be of diagnostic utility.
3. Demonstrates a respectful attitude towards other colleagues and members of the interprofessional team.

LEADER

1. Gains experience in the allocation of finite health care resources, by triaging requests for flow cytometric analysis, cancelling requests where appropriate, and by selecting the minimal number of immunophenotypic markers necessary for accurate diagnosis
2. Develops skill in working closely with laboratory technical staff.
3. Gains expertise in use of CERNER and OACIS computer systems to obtain relevant patient information.
4. Develop expertise in quality control, quality assurance and quality improvement related to flow cytometry to deliver the high quality care.

HEALTH CARE ADVOCATE

2. Responds in a positive way to any opportunities that may arise during the flow cytometry rotation to improve the health of patients and communities.

SCHOLAR

1. Will contribute to the education of residents and laboratory staff by presenting a short topic on flow cytometry. The topic will be decided by mutual agreement following discussion between the resident and the supervising faculty.
2. Shall review the medical literature and make use of the library resources appertaining to diagnostically challenging cases.
3. Strive to integrate new advances into the practice of flow cytometry.
PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in the accurate interpretation of flow cytometric results.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.
4. Shall have appropriate professional behaviours in practice, including honesty, integrity and commitment.

REFERENCE MATERIALS

A. Recommended Texts (available on loan from Resident’s Library (Dr. Xu’s office), and also from Dr. Padmore’s office, General Campus


B. Binder with rotation objectives and reading material will be given to each resident at the start of the rotation.
OUTLINE

Week 1  Basic Genetic principles
        Laboratory procedures and chromosome identification

Week 2  Continuation of Week 1

Week 3  Cancer and Cytogenetics - case assignments/analysis

Week 4  Continuation of Week 3

OBJECTIVES

1. To understand the function of the Cytogenetic Laboratory
2. To learn basic cytogenetic theory as it relates to human diseases with emphasis on non-hereditary cancers
3. To learn basic cell culture procedures, chromosome preparations, banding and staining techniques including FISH
4. To learn basic procedures of chromosome analysis and karyotyping
5. To learn basic nomenclature system.
6. To interpret 2 - 3 cases of hematological neoplasms.
7. To review current guidelines for referring specimens of hematological neoplasms for cytogenetic analysis

MEDICAL EXPERT

The resident will be able to describe and discuss:

- The cytogenetic mechanisms resulting in:
  - Mitosis and Meiosis
  - Mosaicism
  - Clonal evolution
- The techniques used in direct and indirect cytogenetic diagnostic testing including:
  - Fibroblast culture
  - Bone marrow culture
  - Lymphocyte culture
  - Solid tumour culture
- Lymph node culture
- Cell harvesting
- G-banding
- Standard metaphase analysis
- Interphase FISH for the detection of chromosome abnormalities involved in hematologic malignancies

- The indications, contraindications, limitations, sensitivities and specificities of various cytogenetic technologies
- The appropriate methodologies for cytogenetic testing in a given patient situation
- The principles of cytogenetic nomenclature
- Databases used in cytogenetics
- The nature, prognosis and treatment of conditions currently assessed by cytogenetic technology
- Recommendations for additional cytogenetic and/or molecular genetic investigations to clarify the etiology and prognosis of various hematologic disorders
- Types and relative frequency of various chromosomal abnormalities in hematologic disorders

The resident will demonstrate the ability to:
- Perform a standard karyotype with assistance
- Interpret and report cytogenetic test results using standard nomenclature

**COMMUNICATOR**

The resident will demonstrate the ability to:
- Effectively communicate at a level appropriate to referring clinicians and other health care professionals the indications for, methodologies used in, and results of, a variety of cytogenetic tests, including any related uncertainties
- Provide the referring clinician with an understandable written summary of the result
- Communicate effectively with the members of the cytogenetics laboratory, including the laboratory director, technologists and support staff

**COLLABORATOR**

The resident will demonstrate the ability to:
- Respect and consult effectively with the clinical laboratory director, technologists, and support staff to provide optimum patient care
- Where appropriate, be able to assume a leadership role in team settings
- Consult and work cooperatively with research scientists and other disciplines, where applicable, to advance knowledge of cytogenetics and patient care
LEADER

The resident will demonstrate the ability to:

- Allocate cytogenetics test resources wisely
- Utilize information technology to optimize interpretation of test results
- Utilize resources effectively to balance laboratory and learning needs
- Balance personal and professional demands on activities of daily living
- Promote quality assurance as it relates to laboratory results
- Maintain complete and accurate laboratory records

HEALTH ADVOCATE

The resident will be able to describe and discuss:

- How health care governance influences resource allocation for cytogenetic laboratory testing at a local, provincial, regional, and national level
- The roles of national and international agencies in the determination of guidelines for cytogenetic testing

The resident will demonstrate the ability to:

- Recognize and respond to those issues where advocacy for cytogenetic testing is appropriate
- Refer cytogenetic test inquiries to the appropriate laboratory, community and national resources

SCHOLAR

The resident will demonstrate the ability to:

- Critically assess the cytogenetics literature, applying epidemiological and biostatistical principles where relevant
- Develop, implement and monitor a personal continuing education strategy.
- Apply and enhance teaching skills in the education of medical students, other residents and other health care professionals about cytogenetic tests
PROFESSIONAL

The resident will demonstrate the ability to:

- Recognize the limitations of their expertise and skills and seek help whenever indicated
- Recognize his/her own cultural biases that may influence or impede ethical decision-making
- Recognize and demonstrate his/her obligation to effective teaching
- Understand, recognize and respect the role of genetic counsellors, clinical laboratory geneticists, technologists, support staff and researchers.
- Display personal and professional attitudes consistent with a consulting physician
- Understand the duty of confidentiality and the difficulties it can pose in the interpretation and reporting of cytogenetic test results
First Week – General Haematology

- Introduction to the Haematology/TM lab at CHEO.
- Familiarization with CBC analyzers and Coagulation analyzers.
- CSF and body fluid processing and analysis.
- General morphology of peripheral blood and marrow in paediatric population.
- ESR, malaria testing, Monospot testing
- Familiarization with age appropriate normal ranges and values

Second Week – Special Haematology

- Osmotic fragility, G-6PD qualitative and quantitative testing, immunostaining, Heinz body preps.
- Haemoglobinopathy investigation – HPLC and IEF, H prep, sickle solubility test.
- Neutrophil function tests (NBT testing)
- Bone marrow aspirate processing – special stains.

Third Week – Transfusion Medicine

- Familiarization with paediatric and neonatal transfusion protocols.
- Processing and manipulation of blood products.
- Policy and procedures related to paediatric transfusion.

Fourth Week – Coagulation and Review

- Routine coagulation testing.
- Inhibitor testing.
- Review of rotation.
- Exit examination.

GENERAL OBJECTIVES

The general objectives of the Junior Paediatric Haematology/TM laboratory rotation is to provide the resident with foundation the appropriate knowledge and skills to handle and interpret diagnostic tests for children and newborns with hematological and oncological disorders. These knowledge and skills will attain consultant’s level of expertise during the senior Paediatric Laboratory rotation.

The resident is expected to:

1. Know the common Haematology and Oncology disorders of children and newborns. These pathologies are unique for this age and illustrate important genetic, growth, developmental and environmental predispositions.
2. Be aware of the technical problems and requirements pertinent to Haematology tests and procedures for children. Know the appropriate set-up of laboratory diagnostic and transfusion services for these children, e.g. blood procurement, test manuals using minimal blood volume and sedation for bone marrow and lumbar puncture, transfusion procedures for children and newborns.

3. Learn the skills for evaluation, interpretation and reporting of Haematology diagnostic testing for common Haematology and Oncology disorders in children and newborns.

4. Recognize the importance of the collaboration in the ‘comprehensive care team’ practices in a children’s hospital and the vital roles played by the Hematology laboratory and transfusion services.

MEDICAL EXPERT/LEADER

Demonstrate effective utilization of laboratory testing and its interpretation. Demonstrate laboratory skills including:

General Hematology

- Understand the physiology of the different cells in the peripheral blood – white blood cells, red blood cells and platelets. Be familiar with the inherited and acquired disorders that can affect the different cells lines and be able to describe how the laboratory can aid in their diagnosis.
- Basic knowledge of the current haematology and coagulation analyzers and how they function. Knowledge of quality assurance principles.
- Complete blood count (CBC); normal and abnormal. Be able to describe how the various parameters on a CBC are calculated/measured including MCHC, MCV and RDW. Know the different situations where these parameters may be useful in diagnosis.
- Variation for age/sex (e.g. premature infants).
- Familiarization with normal paediatric peripheral blood morphology, and appreciation of the spectrum of normal.
- Recognition of abnormal peripheral blood morphology and the ability to incorporate this into the diagnosis and care of a patient.
- Use morphology for differential diagnosis.
- CSF and body fluid cell morphologies. Understand how a CSF/body fluid cell count is performed.
- Become familiar with the laboratory diagnosis of leukemias and how the Haematopathologist is required to incorporate test results from various laboratories into a concise report.
- Knowledge of the current leukemia protocols and how the Haematology lab plays a role (Day 8, 15, and 29 marrows for evaluation of response).

To understand how laboratory information is used to prognosticate and guide treatment in malignant haematology.
Knowledge of the following:
- How an ESR is performed.
- Reticulocytes measurements.
- Sickle Cell Screen.
- Infectious Mononucleosis Screen.
- Malaria screen and investigation, and reporting protocol
- Ability to recognize and triage situations where investigations need to be expedited.

**Bone Marrow**
- Understand the bone marrow microenvironment and the physiology of haematopoiesis.
- Familiarization with normal and abnormal bone marrow morphology. Be able to interpret bone marrow morphology and incorporate findings into a diagnosis for the patient.
- Be able to subclassify the leukemias according to the WHO classification.
- Be able to evaluate a marrow for evidence of metastatic disease.
- Be able to order the appropriate supplemental tests in the diagnosis of haematopoietic disorders.
- Basic knowledge of the other laboratory techniques that are useful in the diagnosis of haematopoietic disorders (i.e. histochemical stains, cytogenetics, molecular genetics, and immunophenotyping)

**Special Hematology**
- Investigation of haemoglobinopathies: Be familiar with the common techniques: HPLC, IEF, hemoglobin electrophoresis and molecular analysis. Understand the rationale behind the newborn screening program for haemoglobinopathies. Be able to interpret results of testing. Understand the complexity of the hemoglobin molecule and the interaction of the various haemoglobinopathies on the clinical spectrum of disease.
- Red Cell enzyme assays – Be able to describe the major metabolic pathways in the red blood cell and how perturbations result in the various hemolytic anemias. Knowledge of routine testing for enzyme deficiencies.
- Neutrophil function tests.

**Coagulation Tests**
- Knowledge of the coagulation cascade and the fibrinolytic pathways.
- Knowledge of developmental hemostasis.
- Coagulation screening tests: PT, PTT, fibrinogen, FDP.
- Hemophilia investigation, factor assays/inhibitors, molecular genetic studies. Be able to incorporate laboratory results into clinical management decisions.
- Von Willebrand’s disease investigation, molecular genetic studies. Be able to subclassify Von Willebrand's disease.
- DIC work-up.
- Monitor anticoagulants/therapy
Immunohematology (Paediatrics)

- Knowledge of routine pre-transfusion testing: ABO/Rh typing, antibody screening, and X-matching – micro-cross matching system (Ortho-MTS system).
- Direct and indirect anti human globulin testing. Be able to interpret a +DAT and suggest a course of investigation.
- Antibody investigation and familiarization with the major blood group systems.
- Understand the process for investigation of NAIT and platelet antibody testing.
- Neonatal immune screen.
- Investigation of autoantibodies and the laboratory evaluation for autoimmune haemolytic anaemia.
- Investigation of transfusion reactions and their clinical management. Knowledge of the reporting system within Canada for adverse events in transfusion.
- Knowledge of methods of blood conservation.
- Learn appropriate neonatal and paediatric transfusion practices. Understand how these differ in oncology patients and cardiac surgery.
- Knowledge of the risks of transfusion, both infectious and non-infectious.
- Familiarization with the different testing that is performed on blood products by Canadian Blood Services prior to release.
- Know the indications for different types of blood and blood products; irradiated blood, leukoreduced and CMV negative.
- Use of clotting factor concentrates – appropriate use and dosing. Rationale behind prophylaxis vs. on-demand treatment.
- Appropriate use of plasma derivatives.
- Become familiar with Lookback/Traceback investigative protocols.

Learn the special requirements in testing for newborn and children.

- Blood procurement:
  - Micro sampling;
  - IV techniques / IV team.
  - Specialized collection tubes
- Appropriate laboratory instruments for children (using the minimum blood volumes). Impact that low volume requirements have on selection of laboratory equipment
- Organizing battery of tests for diagnosis to minimize specimen volume and avoid repeat sampling.
- Special laboratory requirements to support pediatric acute care services e.g., Emergency, NICU, ICU, Oncology, Cardiovascular Surgery.
- Special laboratory services to support specialized care programs e.g., chemotherapy, hemophilia, hemoglobinopathy and cardiac surgery.
- Computerized information system for order entry, result reporting, archive result, data retrieving and quality assurance analysis.
- Aware of the general principles and regulations on safety of laboratory and transfusion practices in children.
Skills
Demonstrate the ability to perform the following technical skills:
- Intravenous access and blood drawing;
- Slide making – peripheral blood and bone marrow slides.
- Sample procurement – bone marrow aspirate and biopsy collection (optional).

COMMUNICATOR/COLLABORATOR

The Haematology and TM lab at CHEO works closely with the clinicians in The Division of Hematology / Oncology and other subspecialties within the hospital. Due to the nature of paediatric oncology, most of the patients that are evaluated are on study, and close interaction between the laboratory, researchers and clinicians is vital.

Further skills that will be developed during this rotation include:
- Consult effectively with other physicians and health care professionals. Be able to advise colleagues about appropriate testing in the management of patients. Be able to incorporate both clinical and laboratory assessments into patient care.
- Contribute effectively to other interdisciplinary team activities.
- Consult and collaborate with physicians and other health care professionals and contribute effectively to interdisciplinary team activities within and between hospitals, other health care facilities, and collaborative groups.
- Be able to assimilate information from different laboratories into a concise report for the clinical staff (i.e. marrow morphology with Immunophenotyping results).

LEADER

- Utilize resources effectively to balance patient care, lifelong learning needs and personal activities.
  - Demonstrate knowledge and the definition and role of audits, budget reviews, quality improvement, risk management, knowledge of adverse effects/incident reporting, and complaint management in hospital and ambulatory settings.
  - Demonstrate an understanding of the social, societal and governmental aspects of health care provision in the pediatric hematology/oncology population.

HEALTH ADVOCATE

- Recognize and respond to those issues where advocacy is appropriate.
SCHOLAR

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, housestaff/students, and other health care professionals (e.g. laboratory technologists).
- Contribute to the development of new knowledge.
- The resident is expected to organize and give a presentation to laboratory staff during their rotation on a topic related to paediatric laboratory medicine.
- The resident will also give several informal presentations to the attending Haematopathologist on relevant topics.

PROFESSIONAL

- Deliver highest quality health care with integrity, honesty and compassion.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practice medicine ethically consistent with the obligations of a physician.

ROUNDS

The following rounds are held on a regular basis at CHEO. Attendance is not mandatory, but encouraged. Highlighted rounds are particularly relevant. A current schedule is available upon request.

- Hematology/oncology team rounds - Weekly;
- Hematology/Oncology Tumor Board - Bi-weekly and ad hoc;
- Hematology/Oncology Journal Club – Monthly;
- Dept. of Pediatrics Grand Rounds - Weekly ;
- Paediatric Haematology Half-Day Teaching - Weekly ;
- Morphology Rounds with Paediatric Haematology Residents – Monthly.
EVALUATION

Dr. Leung will complete evaluations at the completion of the rotation. The trainee is expected to give a formal presentation to the laboratory staff regarding a relevant paediatric laboratory medicine topic. Evaluations will be done on this. An exit exam consisting of both written and practical component will be administered at the end of the four week rotation.

REFERENCE MATERIALS

4. Pizzo/Poplak – Pediatric Hematological Malignancies, CHEO Library
5. Pui – Childhood Leukemias
6. Andrew, et al. – Thromboembolic Complications during Infancy and Childhood
7. Lanzkowsky – Manual of Pediatric Hematology and Oncology
9. AABB Press – Pediatric Transfusion., Lab Copy
10. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues. 2008.
11. Hoyer/Kroft – Color Atlas of Haemoglobin Disorders
13. Penchansky – Pediatric Bone Marrow
14. Bain – Haemoglobinopathy Diagnosis

APPENDIX I – For Reference Use

List of Hematological and Oncological Disorders that the Resident Should be Familiar with:

**Haematologic Disorders of Newborns:**

<table>
<thead>
<tr>
<th>Common Pediatric Hematological Disorders:</th>
<th>Red Cell Membrane Defects:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Anemia – Congenital</td>
<td>• Congenital Spherocytosis</td>
</tr>
<tr>
<td>• Bone Marrow Failure Syndromes:</td>
<td></td>
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<tr>
<td>• Fanconi Anemia</td>
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<tr>
<td>• Diamond Blackfan</td>
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<tr>
<td>• SDS</td>
<td></td>
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<tr>
<td>• Severe Congenital Neutropenia</td>
<td></td>
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<tr>
<td>• Radial Platelet syndrome (TAR)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Red Cell Enzyme Defects:</th>
<th>Hemoglobinopathy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Glucose – 6 phosphate dehydrogenase deficiency</td>
<td>• Thalassemia</td>
</tr>
<tr>
<td>• Pyruvate Kinase deficiency</td>
<td>• Hemoglobin Variants</td>
</tr>
</tbody>
</table>
Anemia – Acquired:
- Nutritional Iron deficiency
- Hemolytic Uraemic syndrome
- Microangiopathy
- Hypersplenism
- Idiopathic Aplastic Anemia
- Auto Immune Hemolytic Anemia

Leukocyte disorders:
- Neutropenia: congenital and acquired
- Neutrophil function defects
- Use of GCSF
- Chronic Granulomatous disease
- Leukocytosis – Sepsis
- Leukaemoid reactions

Platelet Disorders:
- Thrombocytopenia
- Immunological (ITP)
- MYH9 disorders
- WAS
- Bernard-Soulier and Glanzmann’s
- Granule Defects
- Chediak-Higashi

Coagulation Defects.

Congenital:
- Hemophilia A/B
- Von Willebrand’s disease
- Thrombocytopenia
- Anti Thrombin III and Protein C/S
- Thrombophilia

Acquired:
- Vitamin K disorders/liver disease
- Anticoagulant overdose
- Disseminated intra-vascular coagulopathy (DIC)
Common Pediatric Malignancies:

- Acute leukemia:
  - Lymphoblastic
  - Myelogenous
- Myelodysplastic syndromes
- Brain tumours
- Wilms tumour
- Lymphomas/Hodgkins disease
- Neuroblastoma
- Ewings sarcoma
- Primitive Neuroectodermal tumours (PNET)
- Rhabdomyosarcoma
- Osteogenic sarcoma
- Teratoma, Germ Cells
- Retinoblastoma
YEAR THREE

HEMATOLOGICAL PATHOLOGY

Program Rotations

<table>
<thead>
<tr>
<th>Time</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd Year</td>
<td>Laboratory</td>
</tr>
<tr>
<td>4 weeks</td>
<td>Transfusion Medicine</td>
</tr>
<tr>
<td>8 weeks</td>
<td>Lymphoma Pathology</td>
</tr>
<tr>
<td>4 weeks</td>
<td>Apheresis &amp; Stem cells</td>
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<tr>
<td>8 weeks</td>
<td>Coagulation</td>
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<tr>
<td>12 weeks</td>
<td>Morphology</td>
</tr>
<tr>
<td>4 weeks</td>
<td>Flow Cytometry</td>
</tr>
<tr>
<td>4 weeks</td>
<td>HLA</td>
</tr>
<tr>
<td>4 weeks</td>
<td>Hemoglobinopathies</td>
</tr>
<tr>
<td>4 weeks</td>
<td>Laboratory Management/Quality Assurance</td>
</tr>
<tr>
<td>Day</td>
<td>Time</td>
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<tr>
<td>Monday</td>
<td>08:30</td>
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<td></td>
<td>09:15</td>
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<tr>
<td>Tuesday</td>
<td>08:00</td>
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<tr>
<td>Friday</td>
<td>11:30</td>
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<td>12:00</td>
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</table>

The following processes will be followed:
1. Knowledge mapping
2. Rotation/training
3. Final examination and evaluation
4. Clinical Case Reports (10)
5. Antibody Reports (10)

There will be a short examination prior to the commencement of the rotation to establish baseline knowledge. A final written examination and interview will complete the rotation.

Week 1
- Blood grouping, antibody screening, direct antiglobulin tests and prenatal testing.
- Compatibility testing, antibody identification, antibody problems, elution and blood components, transfusion reactions, and prenatal testing.

Weeks 2-3

Week 4
- Review complex antibodies. Follow up unique transfusion requirements, transfusion weak transfusion reactions, and selection of compatible blood for patients. Quality assurance and administration.

OBJECTIVES
The resident will:
1. Learn to investigate complex antibodies and select compatible blood for patients.
2. Learn all techniques applicable to antibody investigation, elutions, and adsorption.
3. Learn and understand the blood group changes post bone marrow transplantation – selection of blood group for transfusion in transition.
4. Learn the blood component requirement for bone marrow transplant policies (i.e. platelets).
5. Learn blood requirements for intrauterine transfusions.
6. Demonstrate effective consultation skills for patients with an antibody transfusion reaction.
7. Demonstrate knowledge of legal and ethical issues related to transfusion medicine.
8. Demonstrate a knowledge of regulations, standards and QA/QM issues related to transfusion medicine.
9. Communicate transfusion related issues clearly to other healthcare professionals.
10. Understand the fundamentals of transfusion laboratory management.
11. Develop effective educational strategies.
12. Demonstrate ability to assess discordant findings/failed proficiency testing results for the TM lab, including understanding of root cause analysis.
MEDICAL EXPERT

HOSPITAL LABORATORY
Basic serological testing and interpretation
Specialty serological skills
Consultation/interpretive skills

Shall learn specialty serological skills
1. Understand antibody investigation techniques available.
2. Understand investigative tools to resolve discrepancies.
3. Transfusion reaction follow up clinically and technically.

Shall learn blood component requirements for specialized patients (i.e. bone marrow transplant and neonatal)
1. Blood group selection for bone marrow transplant patients.
2. Platelet selection and replacement.
3. Irradiated CMV negative blood components.

Upon completion of the review the Resident will have comprehensive knowledge in:
- Receiving and dispensing
- Inventory management
- Storage of blood/products
- Blood specimen receipt/acceptability
- Blood order cancellation guidelines
- Component preparation, e.g., washed cells, cryo, etc.
- Routine testing
- ABO/Rh, weak D, antibody screen tests
- Resolution of grouping discrepancies, choice of blood for transfusion
- Type & Screen
- Compatibility testing – electronic, routine, emergency, urgent
- Automated procedures in the transfusion laboratory
- Type specific vs. Rh Negative
- Re-cross following issue of Group O
- Massive transfusion
- Component therapy, measurement of component deficiencies
- Dilutional coagulopathies and bleeding diatheses
- Use of colloids, dextran, albumin and hetastarch
- Outcome of transfusion, expected change in hematological parameters
- Transfusion practices, mixing red cells and colloids, warming, blood filter use, rate of transfusion
- Adverse reactions including incompatible transfusion

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Four Weeks Transfusion Medicine Year 3
Dr. E. Saidenberg

- Antibody investigations
  - Case histories,
  - Clinical background/presentation
  - Absorption/elution
  - Rare cell panels/LN2
  - Rare blood registry
- Transfusion reactions – investigation and diagnosis
- Overview of transfusion medicine information system
- Transfusion transmitted disease testing (HBV, HCV, HTLV, HIV)
- Bone Bank – organization, testing requirements, storage
- Prenatal and neonatal testing
- Writing standard operating procedures
- Document control
- Autologous, directed donation program
- Patient/Donor examination (with clinical hematologist)
- Donation of blood
- Fibrin Glue, serum tears
- Total Quality Management and Quality Control
- External quality assessment programs, Standards and regulations

COMMUNICATOR
1. Communicate with Canadian Blood Services to discuss and arrange appropriate cell collections for bone marrow transplant patients.
2. Communicate with high risk pregnancy group regarding cordocentesis.
3. Communicate with bone marrow transplant group regarding individual requirements for specialized products for patients

LEADER
1. Develop organizational skills to ensure that appropriate specialized blood products are available for bone marrow transplantation
2. Learn to manage the blood supply to accommodate requirements for phenotypic bloods

HEALTH CARE ADVOCATE
1. Be able to identify specific requirements of bone marrow transplant patients.
2. Recognize transfusion requirements of patients with antibodies

SCHOLAR
Review medical literature pertaining to antibody identification and critically appraise sources.

PROFESSIONAL
Liaise effectively with bone marrow transplant practitioners
COMPETENCY CHARACTERISTICS

1. The resident will be able to evaluate a situation involving complex antibodies and select compatible blood groups for patients following appropriate testing.

2. The resident will understand the intricacies of obtaining blood and stem cells and the support of the patient undergoing bone marrow transplantation.

EVALUATION

A written and practical examination will be carried out at the end of the rotation.

REFERENCES

1. Transfusion
2. Transfusion Medicine
3. Vox Sanguinis
4. AABB Technical Manual
5. AABB Standards
6. Blood Transfusion in Clinical Medicine, Mollison, Engelfried, and Contreras.
OUTLINE

Monday  09:00  Autopsy Rounds, if hematologic cases
        11:00  Attends pathology case presentation if hematologic
Thursday 08:00  Lymphoma Rounds
Thursday 15:30  Morphology Rounds
Friday  12:00  Clinical Hematology Rounds

SPECIFIC OBJECTIVES

At the completion of training, the resident will have acquired the following competencies and will function effectively as:

MEDICAL EXPERT/CLINICAL DECISION-MAKER

General Requirements

1. Demonstrate sound knowledge of WHO lymphoma classification.
2. Demonstrate diagnostic skills for accurate diagnosis of lymphoproliferative disorders in a variety of organs.
3. Access and apply relevant information to clinical practice.
4. Demonstrate effective consultation services with respect to referred in consultation cases.

Specific Requirements

1. Demonstrate knowledge of normal anatomy, physiology and immunology of the lymphatic/immune system.
2. Demonstrate understanding of the general principles of embryologic development and the commoner variations of normal lymph nodes, spleen, thymus and bone marrow.
3. Demonstrate a superior and detailed knowledge of the normal gross and light microscopic appearance of lymph nodes, spleen and other lymphoid tissues.
4. Understand the basic principles of cell biology, immunology and pathogenesis, and the changes that occur in specific lymphomas.
5. Be familiar with the CD classification of lymphocyte antigens and their application to immunophenotyping of lymphoproliferative disorders.
6. Understand the principles of immunohistochemical diagnosis in malignant and inflammatory conditions.
7. Understand the principles of tissue processing and the use of different fixatives in the laboratory.
8. Demonstrate an in-depth knowledge of the appropriate processing and sampling of biopsy specimens for suspected lymphoma.
9. Understand the principles of nucleic acid-based molecular biology techniques and be familiar with their application to diagnosis in lymphoma diagnosis, especially the role of PCR and Southern blotting in gene rearrangement, lineage and specific translocation studies.

10. Understand the overall approach to examining a lymphoid organ microscopically, formulating a differential diagnosis based on histologic features and proceeding with the selection of confirmatory immunophenotyping.

11. Be familiar with the WHO classification of lymphoproliferative disorders and their clinical significance.

12. Understand the diagnostic pitfalls in interpreting biopsy tissues, including sample size, fixation problems, etc.

13. Demonstrate ability to take satisfactory gross and microscopic photographs of lymphoid tissues, including digital presentations of individual cases for teaching purposes.

COMMUNICATOR

**General Requirements**

1. Discuss cases with other members of the health care team in terms of diagnosis and prognosis.

**Specific Requirements**

1. Assist in the continuing education of physicians and other members of the hospital staff by participating in educational/clinical review forums such as lymphoma rounds.

2. Act as consultants to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.

3. Understand the information a pathology report should provide in a given clinical situation and be able to communicate it effectively in an oral and written form.

COLLABORATOR

**General Requirements**

1. Consult effectively with other physicians and health care professionals.

2. Contribute effectively to other interdisciplinary team activities.

3. Understand the role of the pathologist as “gate-keeper” in patients entering clinical trials

**Specific Requirements**

1. Must have experience in clinical medicine and surgery sufficient to achieve a sound understanding of the effects of disease and the role of pathology in its management.

2. Demonstrate the ability to advise on the appropriateness of obtaining histologic and cytologic specimens and following examination of these, to advise on further appropriate investigations.
LEADER

**General Requirements**
1. Utilize resources of the pathology laboratory effectively to achieve an accurate diagnosis.
2. Allocate finite health care resources wisely.
3. Work effectively and efficiently in a health care organization.
4. Utilize information technology to optimize patient care, life-long learning and other activities.

**Specific Requirements**
1. Demonstrate knowledge of the methods of quality control in the laboratory as it relates to flow cytometry and immunohistochemistry of lymphoproliferative disorders.

HEALTH CARE ADVOCATE

**General Requirements**
1. Identify the important determinants of lymphoma pathogenesis and diagnosis.

**Specific Requirements**
1. As members of an interdisciplinary team of professionals responsible for individual and population health care, the anatomical pathologist will endeavour to help in informing the public about issues surrounding the diagnosis of lymphomas and risk factors for their development.

SCHOLAR

**General Requirements**
1. Develop, implement and monitor a personal continuing education strategy with respect to continuing education in lymphoma pathology.
2. Critically appraise sources of medical information and recognize the current best sources for lymphoma research reporting.
3. Facilitate learning of patients, house staff/students and other health professionals at rounds.
4. Contribute to development of new knowledge.

**Specific Requirements**
1. A small research project or case report should be discussed with the rotation supervisor at the beginning of the elective. This could be presented at any one of a number of forums ranging from lymphoma rounds to national meetings.
PROFESSIONAL

General Requirements

1. Deliver highest quality care with integrity, honesty and compassion.
2. Exhibit appropriate personal and interpersonal professional behaviours.
3. Practice medicine ethically consistent with obligations of a physician.
4. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

1. Act as an appropriate role model for students and others.
2. Demonstrate a professional attitude to colleagues, as well as to other laboratory staff.
3. Have an appreciation of the crucial role of the anatomical pathologist in providing quality patient care. This will include knowledge of individual professional limitations and the necessity of seeking appropriate second opinions.

KNOWLEDGE

1. Shall recognize tumors of lymphoid tissue and the main reactive condition of lymph nodes. Produce reports of these and signs them out with staff pathologist.
2. Correlates flow cytometry and DNA studies with morphologic findings and produces clinically relevant reports.
OUTLINE

Rounds: Friday 11:30am Apheresis Rounds: OBDC Conference Room L2247

On Call: On-call for pheresis, Monday to Friday, 8:00am to 5:00pm.

TOH: pheresis: in-house cases, monitors adverse reactions,
Weeks 1 – 3 participates in apheresis rounds, takes on-call for pheresis issues
Week 4 CBS: stem cell lab. Clinic operations, donor recruitment, inventory, transmissible disease testing and quality assurance

OBJECTIVES
1. To understand the principles of apheresis technology
2. To know the evidence-based indications for therapeutic apheresis
3. To know the appropriate replacement fluids for therapeutic apheresis
4. To understand and manage the adverse reactions associated with pheresis procedure
5. To understand the principles of photopheresis
6. To understand the principles of collection of blood components by pheresis (platelets, red cells, plasma) and donor selection
7. To understand the principles of stem cell collection and cyropreservation

MEDICAL EXPERT
1. Principles of apheresis technology
2. Indications for therapeutic apheresis, Principles of apheresis blood component and stem cell collection

COMMUNICATOR
1. The resident will be responsible for communicating with Ottawa Hospital apheresis program staff and nurses on a daily basis.
2. Resident will write apheresis orders
3. Resident will chart on apheresis patients as appropriate
4. Resident will manage adverse reactions to apheresis as appropriate

COLLABORATOR
1. On-call for pheresis, with back-up, to assess patients for therapeutic apheresis, and manage issues related to therapeutic apheresis as they arise
2. Learn the principles of running a stem cell cryopreservation laboratory.
LEADER

1. Resident to understand administrative aspects of providing therapeutic apheresis
2. Resident to learn issues related to donor assessment and retention as it pertains to apheresis blood component donation. Resident to understand the role of apheresis blood component collection as part of general strategies to meet demand for blood for routine transfusion and for transfusion in special populations.

SCHOLAR

Resident will gain an in depth understanding of the literature supporting or refuting apheresis therapy in management of a given medical condition

COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:
1. knowledge of the principles and procedures of apheresis procedures.
2. knowledge of specimen requirements and handling for various tests currently in use in the apheresis and stem cell labs.
3. an understanding of what information is required by the clinicians and how to interpret the results generated in the stem cell lab.

EVALUATION

Oral and/or written examination/seminar

REFERENCE MATERIAL

1. Transfusion Medicine Reviews

2. Journal of Therapeutic Apheresis


OUTLINE
• Attend thrombosis clinic

Week 1
• Platelet function tests: understand role and interpretation of platelet function testing and electron microscopy.
• Know role of flow cytometry.

Week 2
• HIT, TTP
• Understand the pathophysiology and clinical significance of HIT and HITT
• Understand the tests used for diagnosis of HIT and their operating characteristics
• Understand the mechanism of action and clinical use and monitoring of drugs used in HIT
• Understand the role of laboratory testing in diagnosis and management of TTP.

Week 3
• Understand tests for thrombophilia
• Learn and understand the molecular basis of thrombophilias
• Learn and understand the epidemiology and clinical significance of the thrombophilias
• Understand pre-analytic variables that impact thrombophilia testing

Week 4
• Anticoagulants
• Mechanism of action of all anticoagulants
• Principles and tests of monitoring
• Reversal of anticoagulant effect

Week 5
• Hereditary bleeding disorders
• Understand the clinical and molecular basis of hereditary bleeding disorders
• Learn the tests for these bleeding disorders; understand quality issues in factor level testing
• Principles of treatment and monitoring
• Learn principles of factor inhibitor testing

Week 6
• Hepatocellular disease
• Understand the hemostatic abnormalities caused by synthetic liver disease
• Learn the tests to evaluate the different conditions
• Principles of treatment at biopsy or surgery
• How to monitor response

Week 7
• Massive transfusion
• Learn the hemostatic defects associated with massive transfusion
• Learn the defects in transfusion in cardiac surgery and trauma surgery
• Understand the tests and transfusion principles

Week 8
• Disseminated intravascular coagulation
• Understand the conditions leading to DIC and understand the defects seen in DIC
• Learn the tests that depict DIC and understand the principles of treatment
OBJECTIVES

1. Assessment of patient disorder, determination of appropriate diagnostic test and appropriate interpretation of results.
2. Understand the molecular basis of platelet dysfunction; know how to test for this.
3. Understand the role of the vascular endothelium in thrombosis and hemostasis.
4. Understand the molecular basis of the hereditary disorders of coagulation proteins.
5. Understand the use of laboratory tests in the definition of hemostatic and thrombotic disorders.
6. Understand the principles and measurement of fibrinolysis.
7. Understand the principles of a thrombophilia workup and appropriate therapy.
8. 

MEDICAL EXPERT

1. Learn and understand the molecular basis of thrombophilias.
2. Learn and understand the epidemiology and clinical significance of the thrombophilias.
3. Understand the mechanism and action of oral and parenteral anticoagulants.
4. Understand the test principles of monitoring anticoagulants.
5. Understand the pathophysiology and clinical significance of HIT and HITT.
6. Understand the tests and sensitivities of HIT assays.
7. Understand the mechanism of action and clinical use and monitoring of drugs used in HIT.
8. Understand the pathophysiology and assays for TTP.
9. Understand the pathophysiology clinical and testing of patients with hepatocellular dysfunction.
10. Understand the hemostatic changes in various malignant states.
11. Understand mechanism and dosing of blood products used in disorders of hemostasis.
12. Understand and interpret tests of platelet function.
13. Understand quality issues in the coagulation laboratory.
14. Demonstrate ability to assessment discordant findings/failed proficiency testing results for the coagulation lab, including understanding of root cause analysis

COMMUNICATOR

- Imparts new knowledge to other residents by presentations and rounds.
- Writes clear reports of results of testing.
- Writes appropriate test interpretations and communicates critical results as indicated.
- Communicates verbally any urgent results and coordinates further testing if required.

LEADER

Develops skill in working closely with laboratory technical staff.

HEALTH CARE ADVOCATE

1. Makes selection of cases for further diagnostic testing
2. Responds positively to interpretive possibilities during the rotation to improve patient health
SCHOLAR

1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on weekly topics. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in hemostatic testing
2. Shall respond promptly and helpfully to requests for assistance
3. Shall work effectively and collaboratively with laboratory staff

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:

1. Have refreshed skills in hemostasis and bleeding
2. Be able to interpret all tests of hemostasis and bleeding

EVALUATION

1. Successful completion of the self-assessment cases.
2. Evaluation of seminar presentation

REFERENCE MATERIALS

1. Consultative Hemostasis and Thrombosis
   C. S. Kitchens, B. M. Alving, C. M. Kessler, 2002
   ISBN # 0-7216-8264-2
2. Disorders of Hemostasis and Thrombosis, a clinical guide
   S. H. Goodnight, W. E. Hathaway
   ISBN # 0-07-134834-4
3. Binder with objectives and reading material for the rotation is available from the supervisor
4. Handouts covering main topics will be provided: publications & powerpoint presentations
5. Additional references and reading material available from the supervisor
Twelve Weeks Morphology Year 3
Drs. R. Padmore & Members of the Division

OUTLINE

Rounds
Monday  08:30  Program Director’s Rounds
        09:15  Hemepath academic half day
Thursday  08:00  Leukemia/Lymphoma Rounds
Friday   12:00  Clinical Hematology Rounds

Weeks 1 to 4
General Campus.  Refresh morphologic skills by actively participating in daily peripheral blood smear review.  Review and sign out bone marrow cases with staff.  Instruct junior residents in morphology.  May spend a few hours per week at Civic Campus, to see morphology of different patient population.

OBJECTIVES

This rotation is provided in third year, as a refresher in morphology skills.  The primary emphasis in this rotation is on the development of the resident as medical expert.  Morphologic interpretation of peripheral blood and marrow is a fundamental skill of hematopathologists.  During this rotation, the resident will have the opportunity to apply the experience of the first two years of residency training to the morphologic interpretation of peripheral blood and bone marrow.  As well, the resident will develop an approach to the review of the body fluid slides which are prepared in the hematology laboratory, for the body fluid differential counts, with correlation with cytopathology/cytology reports, where appropriate.  The resident will also be given the opportunity to develop in the role of the specialist as a professional responsible for the teaching of more junior residents.

Expectations:
The resident is expected to spend most of the day in the multihead microscope room, Room 3882, to be readily available for review of peripheral blood and bone marrow slides with the hematopathology staff and clinical hematologists.  It is the responsibility of the resident each day to summarize the clinical history and review the peripheral blood films, body fluid slides and bone marrows.

For graded responsibility:
- The resident will review and write comments on all PB/body fluid slides independently.  For routine PB/body fluid cases, the resident will do final sign out.  The resident will bring all challenging PB/body fluid cases to staff hematopathology for final sign out.
- The resident will review and write at least 60 marrow reports independently, and bring these marrows to staff hematopathologist for final sign out.

The resident is expected to do at least one presentation, either at leukemia rounds or academic half day on a topic in morphology.
MEDICAL EXPERT
1. Shall review the peripheral blood morphology of red cells, white cells and platelets in health and disease.
2. Shall review the red cell indices that support morphologic interpretation of the peripheral blood. Shall review the instrumentation of the cell counters that generate the red cell indices.
3. Shall understand and be able to trouble-shoot peripheral blood abnormalities that may interfere with the generation of the automated CBC.
4. Shall review bone marrow morphology in health and disease.
5. Shall develop an approach to the review of body fluid differential slides prepared in the hematology laboratory.

COMMUNICATOR
1. Develops expertise in writing succinct peripheral blood and bone marrow reports, incorporating the results of special studies (flow cytometry, cytochemical stains, PCR), where appropriate.
2. Explains to clinicians the significance of morphologic findings.
3. Consults with clinical colleagues concerning problems of morphologic interpretation.

COLLABORATOR
1. Consults with other laboratory medicine specialists to arrange other relevant diagnostic tests (e.g. special stains, PCR).
2. Consults with clinical colleagues to suggest when bone marrow examination might be of diagnostic utility.

LEADER
1. Develops skill in working closely with laboratory technical staff and with junior residents.
2. The resident is expected to organize at least one QA morphology rounds.

HEALTH CARE ADVOCATE
1. Responds in a positive way to any opportunities that may arise during the morphology rotation to improve the health of patients and communities.

SCHOLAR
1. Will contribute to the education of residents and laboratory staff by presenting a seminar on an advance aspect of peripheral blood and/or bone marrow morphology. The topic will be decided by mutual agreement following discussion between the resident and the supervising faculty.
2. Shall review the medical literature and make use of the library resources appertaining to diagnostically challenging cases.
PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in the accurate interpretation of peripheral blood and bone marrow morphology.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.
4. Shall spend most of the day in the multihead microscope room, Room 3882, to be readily available for review of peripheral blood and bone marrow slides with the hematopathology staff and clinical hematologists.

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:
1. Have refreshed skills in the morphologic interpretation of peripheral blood and bone marrow.
2. Display in-depth knowledge of the parameters generated by the cell counter.
3. Be able to interpret morphologic findings in the peripheral blood and bone marrow, generate a report containing the relevant information, and communicate the results in a timely fashion to the clinician.
4. Demonstrate an ability to instruct more junior residents in the interpretation of peripheral blood and bone marrow morphology.

EVALUATION

1. Successful participation in weekly morphology quizzes.
2. Evaluation of seminar or leukemia rounds presentation.

REFERENCE MATERIALS

Recommended Texts

OBJECTIVES

Flow cytometry is an important diagnostic tool in the investigation of hematological disorders. While the methodology is relatively straightforward, the technical aspects may be challenging, and the interpretation of results, complex.

The 3rd year resident is expected to have a solid grounding in the classification and morphological diagnosis of hematological malignancies. The aim of this rotation, building on this foundation, is the in-depth understanding of flow cytometry in the diagnosis of hematological malignancies. The resident also becomes in the competent triage of specimens for flow cytometry immunophenotyping and in the diagnostic interpretation of applications of flow cytometry in other areas of hematology, including in the assessment of bleeding disorders, fetal/maternal hemorrhage and immune dysfunction.

The primary emphasis in this rotation is on the development of the resident as medical expert. The diagnostic information provided by the technique of flow cytometry is often critical to patient management. During this rotation, the resident will be trained in the interpretation of flow cytometric data, and shall become acquainted with common diagnostic pitfalls. Other aspects of medical expert particularly germane to this rotation are the role of the specialist as communicator (conveying the interpretation in a timely fashion to clinicians), and leader (The resident will become competent in the triage of specimens for flow cytometry immunophenotyping. This includes choosing the most applicable flow panel, and allocating finite health resources wisely by learning how to appropriately cancel cases when not indicated, and using abbreviated panels if possible), and scholar (in keeping abreast of recent advances in the field of flow cytometry).

MEDICAL EXPERT

7. Shall understand and become competent in triaging cases for flow cytometry immunophenotyping.
9. Correlates morphology and DNA studies with flow cytometric findings.
11. Develop a more advanced understanding of the principle and practice of measurement of platelet surface markers by flow cytometry.
COMMUNICATOR

4. Develops expertise in writing succinct flow cytometric reports, which are clear, accurate and appropriate and timely.
5. Explains to clinicians the significance of the immunophenotypic markers and their diagnostic application.
6. Consults with clinical colleagues about problems of flow cytometric interpretation.

COLLABORATOR

4. Consults with other laboratory medicine specialists to obtain other relevant diagnostic tests (e.g. special stains, PCR).
5. Consults with clinical colleagues to suggest when flow cytometric analysis might be of diagnostic utility.
6. Demonstrates a respectful attitude towards other colleagues and members of the interprofessional team.

LEADER

5. Gains experience in the allocation of finite health care resources, by triaging requests for flow cytometric analysis, cancelling requests where appropriate, and by selecting the minimal number of immunophenotypic markers necessary for accurate diagnosis
6. Develops skill in working closely with laboratory technical staff.
7. Gains expertise in use of CERNER and OACIS computer systems to obtain relevant patient information.
8. Develop expertise in quality control, quality assurance and quality improvement related to flow cytometry to deliver the high quality care.

HEALTH CARE ADVOCATE

3. Responds in a positive way to any opportunities that may arise during the flow cytometry rotation to improve the health of patients and communities.

SCHOLAR

4. Will contribute to the education of residents and laboratory staff by presenting a short topic on flow cytometry. The topic will be decided by mutual agreement following discussion between the resident and the supervising faculty.
5. Shall review the medical literature and make use of the library resources appertaining to diagnostically challenging cases.
6. Strive to integrate new advances into the practice of flow cytometry.
PROFESSIONAL

5. Shall deliver the highest quality care by developing expertise in the accurate interpretation of flow cytometric results.
6. Shall respond promptly and helpfully to requests for assistance.
7. Shall work effectively and collaboratively with laboratory staff.
8. Shall have appropriate professional behaviours in practice, including honesty, integrity and commitment.

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:
1. Have an in-depth understanding of the principles and procedures of flow cytometry.
2. Display knowledge of specimen requirements and handling for the various flow cytometric analyses currently in use in the laboratory.
3. Be able to appropriately triage cases for flow cytometric analysis, either by selecting the appropriate panel, or, after discussion with the clinician, cancelling the request.
4. Be able to interpret flow cytometric results, generate a report containing the relevant information, and communicate the results in a timely fashion to the clinician.

EVALUATION

1. Written examination
2. Evaluation of seminar presentation

REFERENCE MATERIALS

Recommended Texts (available on loan from Resident’s Library (Dr. Xu’s office), and also from Dr. Padmore’s office, General Campus
OUTLINE

Week One  Overview of MHC and the test procedures used in the Tissue Typing lab - serologic HLA typing and crossmatches. Review of protocols used for selecting matched donors for solid organs and bone marrow transplantation. Role of HLA in solid organ transplantation, bone marrow transplantation, disease susceptibility and platelet transfusion. Screening for panel reactive antibody (PRA) and the role of T and B cell crossmatches in renal transplantation. Observe HLA typing and crossmatches. Clinical Component: Review patient reports with the supervisor. Attend weekly clinical BMT/HLA meeting, every Wednesday morning, 8:30 – 9:30am

Week Two  Overview of DNA methodologies used for HLA typing for transplantation and disease susceptibility. HLA genotyping to select the best matched donor within a family. Observe DNA-HLA typing by PCR-SSP method-preparation of DNA, specific amplification by PCR, test setup and interpretation and reporting of results. Clinical Component: Review the role of HLA matching in BM transplantation. Review patient reports with the supervisor. Attend weekly clinical BMT/HLA meeting, every Wednesday morning, 8:30 – 9:30am

Week Three  Overview HLA Tetramers, NK cell receptors, and monitoring of BM engraftment by the STR/VNTR method. Observe routine DNA-PCR and RT-PCR tests as used in the lab for gene mutations. Review QA and QC protocols. Clinical Component: Discuss interpretation and reporting of results with the supervisor. Attend weekly clinical BMT/HLA meeting, every Wednesday morning, 8:30 – 9:30am


OBJECTIVES
Serologic and molecular assays are important in selecting a suitable donor for BM and solid organ transplantation. There have been many new advances in this specialized field. The resident will be exposed to various methodologies currently available and the ones used in our lab. The resident will meet with the supervisor each morning to discuss the resident’s goal for that day and again in the afternoon to review and discuss what was learnt.

The resident is expected to have a background in immunology, basic cellular biology, leukocyte markers and an understanding of DNA replication, transcription, as well as the DNA replication errors and mutations that can occur.
SPECIFIC OBJECTIVES

MEDICAL EXPERT

1. Exposure to serologic and DNA methodologies used in the Tissue Typing, Diagnostics and Flow Cytometry laboratory.
2. Overview of QA/QC procedures specific to the test procedures used.
3. Exposure to proficiency testing results and their role in providing the highest quality of results for patient safety.
4. Exposure to molecular diagnostic techniques for lymphoma/leukemia.
5. Exposure to flow cytometry for crossmatches in renal transplantation.
6. Seminar and/or didactic discussion on selected topics related to this rotation.

COMMUNICATOR/COLLABORATOR

The resident will be encouraged and expected, on a one-to-one basis, to collaborate and communicate with the technical staff and the supervisor on a daily basis.

LEADER/HEALTH CARE ADVOCATE

The resident will have opportunity to discuss QA/QC issues, utilization of resources, budgetary considerations, and the utilization of new technology with the aim of developing managerial skills.

SCHOLAR

Opportunity will also be available for scholarly activities and continuing education by way of participation in scheduled seminars/rounds, resident’s presentations and researching medical information relevant to the topics covered in the rotation.

PROFESSIONAL

The resident will be expected to work with integrity, honesty and to maintain the highest ethical standards.

COMPETENCY CHARACTERISTICS

By the end of rotation the resident should have:

1. Knowledge of the role of histocompatibility molecules and the principles of various methods of histocompatibility testing.
2. Knowledge of specimen requirements and handling for various tests.
3. An understanding of how tissue typing testing is applied to clinical medicine.
4. An understanding of what information is required by the clinicians and how to interpret the results generated in the lab.
CanMEDS competencies

The main emphasis will be on the activities related to the rotation as specified above as this is a 1st year program. However, there will be opportunities to develop other CanMEDS recommended skills.

EVALUATION

Written and/or oral examinations/seminars

REFERENCE MATERIALS

- Immunogenetics: Methods and Applications in Clinical Practice by Frank T. Christiansen (Editor), Brian D. Tait (Editor). Humana Press. Publication Date: Jun 8 2012 ISBN-10: 161779841X
- Binder with objectives and reading material for the rotation is available from the supervisor
- Handouts covering main topics will be provided: publications & powerpoint presentations
- Additional references and reading material available from the supervisor
Four Weeks  Hemoglobinopathies  Year 3
Senior Rotation
Dr. E. Leung, Dr. E. Saidenberg, Dr. R. Padmore

WEEKLY SCHEDULE/OBJECTIVES
The hemoglobinopathy rotation will be done both at CHEO and at The Ottawa Hospital, General Campus. Both laboratories perform hemoglobinopathy investigations, but the patient population is quite different at each site; residents will benefit from reviewing cases from both sites. The resident will coordinate with Drs. Leung and Saidenberg how best to divide their time between CHEO and The Ottawa Hospital, General Campus, to obtain the most benefit from this rotation. The trainee is expected to interpret all the haemoglobinopathy gel runs at both CHEO and The Ottawa Hospital, and to review these results with staff hematopathologists. The resident is expected to give a seminar presentation during the rotation. The resident will meet with Dr. Padmore at the end of weeks one and two, to go over the self-assessment questions from Chapter 8 in the textbook by Barbara Bain: “Haemoglobinopathy Diagnosis.”

During the second year, the resident did an introductory rotation in Hemoglobinopathies. This third year senior rotation is designed to review the material from the first year and increase the resident’s knowledge base in hemoglobinopathies. Residents will take on a more senior role and be expected to triage all investigations as well as partake in EQA challenges.

Week 1 - Review of laboratory techniques used in haemoglobinopathy investigation. Review of basic physiology and pathophysiology as it pertains to the haemoglobinopathies.
Week 2 – Review of the thalassemic syndromes (α thalassemia, β thalassemia,) and common hemoglobin variants (Hb S, C, E, D, O-Arab).
Week 3 - Paediatric Focus (see appendix 3)
Week 4 - Screening methods and aims. Familiarization with rare variants (HbMs, low oxygen affinity Hb, etc.) (see appendix 4).

There is the possible option of a 1 or 2 week elective at the Regional Hemoglobinopathy Genetics Laboratory in Hamilton, Ontario.

OBJECTIVES

MEDICAL EXPERT

- To understand the physiology of the hemoglobin molecule
- To understand the underlying pathophysiology of thalassemias and variant haemoglobins. To be able to describe the difference in the types of mutations between alpha-thalassemia and beta-thalassemia (large deletions vs. point mutations) and the implication on diagnostic testing.
- To learn to recognize hemoglobinopathies from peripheral blood indices and morphology.
- To review and observe the various laboratory techniques used to diagnose the hemoglobinopathies.
• To have a basic understanding of the molecular technologies used in the diagnosis of the haemoglobinopathies.
• To learn the specifics of hemoglobin electrophoresis, HPLC and Isoelectric focusing
• To understand the clinical implications of the haemoglobinopathies.
• To have a good understanding of the current management of the sickling disorders, including transfusion related implications.
• To have an organized approach to the diagnosis and investigation of the haemoglobinopathies as outlined in recent practice guidelines.
• To have experience investigating rare variants or non-routine cases.
• To demonstrate ability to assess discordant proficiency testing results and hemoglobinopathy IQMH case studies

COMMUNICATOR

1. Reviews and reports all haemoglobinopathy studies
2. Teaches through rounds and one-on-one sessions with the laboratory staff, as confidence is gained through the rotation.
3. Brings gleaned knowledge from the literature back to the laboratory staff on diagnostically challenging cases.
4. Be able to recommend further testing to referring services as warranted.

COLLABORATOR

1. Reviews low MCV cases in lab, consults with other laboratory medicine specialists and selects cases for haemoglobinopathy investigation.

LEADER

1. Develops skill in working closely with laboratory technical staff.

HEALTH CARE ADVOCATE

1. Makes selection of cases for further diagnostic testing.
2. Responds positively to interpretive possibilities during the rotation to improve patient health.
3. Be familiar with the principles of prenatal/antenatal/neonatal screening programs and their impact on population health.
SCHOLAR

1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on hemoglobinopathies. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in Hemoglobinopathies.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:

- Have refreshed skills in hemoglobinopathies
- Be able to interpret all haemoglobinopathy investigations. Be able to suggest a course of investigation for non-routine cases.

EVALUATION

1. Successful completion of the self-assessment cases and completion of the questions as required in the appendices.
2. Evaluation of seminar presentation.
Appendix 1

**Week 1** Review of laboratory techniques used in haemoglobinopathy investigation. Review of basic physiology and pathophysiology as it pertains to the haemoglobinopathies.

1. Shall review hemoglobin genetics and structure.
2. Shall review expression and inheritance of Hb and changes noted with age.
3. Shall review smears for morphology (normal and abnormal hemoglobinopathies)
4. Shall review slides of thalassemia cases (minor, major, hydrops fetalis).
5. Shall review HB H inclusion morphology, distinguish from artifact and reticulocytes.

6. Shall review how samples are chosen for haemoglobinopathy testing.
7. Shall prepare hemolysate, and run alkaline and acid electrophoresis, IEF.
8. Shall review Hb separation methods. Shall review isoelectric focusing, HPLC and hemoglobin electrophoresis testing principles.
10. Shall review location of sickle band on alkaline gel, acid gel, isoelectric gel, Variant II (HPLC).
11. Shall understand the significance of Hb S interactions with other variant Hb.
12. Shall review pathophysiology of low MCV, and lab test methods to distinguish between iron deficiency, anemia of chronic disease and thalassemia syndromes.
13. Shall review diagnostic tests for thalassemia syndromes. Shall be aware of the differences in the types of mutations between alpha thalassemia and beta thalassemia (gap mutations vs. point mutations) and the implication for diagnosis.
14. Shall perform HB A2 and F quantitation using HPLC (Variant). Shall appreciate the normal increase noted in Hb F levels during the first year of life.
15. Shall perform calculation for fetal Hb containing cells.
16. Be able to interpret both straightforward and complex haemoglobinopathy investigations.
17. Familiarity with molecular testing as it pertains to haemoglobinopathy evaluations.
18. Review and report all haemoglobinopathy studies.

**Required reading:** Bain, Chapters 1, 2, and 4, Bain, chapter 8: self-assessment cases 8.- 2, 8, 10, 14, 15. Review on Bain CD, hemoglobinopathies: hematologist: questions 1 – 29.
Appendix 2

**Week 2** Review of the thalassemic syndromes (α thalassemia, β thalassemia and common hemoglobin variants (Hb S, C, E, D, O-Arab).

**Required reading:**

Read Bain: Chapters 3, 5.
Do Bain, chapter 8: self-assessment cases 8. – 3, 4, 5, 7, 9, 11, 12, 18, 19, 21, 22, 23, 24.
Review Bain CD: hemoglobinopathies: hematologist: questions 33 - 51

Appendix 3

**Week 3 Paediatric Focus**

1. Prenatal/Antenatal screening.
2. Ontario Newborn Screening Program.
3. Review of interesting paediatric cases.
4. Shall appreciate the limitations/challenges of haemoglobinopathy testing in the paediatric population.

Appendix 4

**Week 4 Screening methods and aims. Familiarization with rare variants (HbMs, low oxygen affinity Hb, etc.)**

1. Review algorithms for screening in the following circumstances: Prenatal/Antenatal, Neonatal, Lab generated, low MCV testing.
2. Shall understand the process and rationale behind newborn screening for the haemoglobinopathies. Be able to investigate a positive screen result appropriately.
4. Perform calculation for fetal Hb using Kleihauer assay
5. Review low MCV cases in lab for checking that week and select cases for haemoglobinopathy testing
6. Review of rare variants and interesting cases, including HbMs, low oxygen affinity Hb, Hb Quebec-CHORI, Hb C-Harlem.
Recommended Textbooks/References

OUTLINE

Week 1  Theory of Quality Assurance and statistical tools
Week 2  Quality Assurance of hematological instruments in all laboratories
Week 3  Setting up and implementing evaluations for instrumentation
Week 4  Developing and setting up lab management systems

Introduction

To be effective, a good quality assurance and lab management program must:

1. Be appropriate, realistic, achievable, cost-effective, clear, concise, and organized.
2. Ensure believable results, ensure accuracy and precision of all test results, detect errors before they can affect patient results, enable prompt corrective action.
3. Be comprehensive, involve all staff performing the tests, cover all tests (methodologies and equipment) performed through the different shifts, and meet all legislative and accreditation needs.

OBJECTIVES

The resident will develop a quality assurance program that includes planning, implementation and follow up procedures. Planning requires a decision on what is to be controlled and to what degree (quality assurance goals). The how, when and by whom this is achieved will form the basis of this program. Continuing monitoring and review ensures the program meets its goals and the goals are valid. This is laboratory management.

The resident will learn that any change in equipment, workflow, methodology or staffing may require a change in the quality assurance program.
MEDICAL EXPERT

The resident will learn the concepts of components of the quality assurance program as follows:

**Tests and equipment to be controlled**
The method and/or equipment will determine the types of controls, calibrations and monitoring required. Factors involved include:
1. Manual vs. automated methods
2. Linearity of results
3. Clinically useful range
4. Stability; how frequently it needs to be checked
5. Availability of controls and calibrators
6. Computerization
7. Moving averages (Bull’s)
8. Sensitivity, specificity, negative predictive value

**Frequency of Quality Control Testing**
The frequency of Quality Control testing is usually tied to the analytical run (i.e., number of patient samples run at one time), which in turn is influenced by the stability of the methodology / equipment, work flow and number of patient specimens. Quality Control testing guidelines include:
1. Size of the analytical run
2. Calibration intervals (if applicable)
3. Whether Quality Control material must be used with each analytical run
4. Interval between runs before Quality Control must be repeated
5. Change in stability
6. Change in accuracy of equipment or methodology

**Types of Controls and Standards**
The types of controls and standards that can be used will vary according to the equipment or methodology. Some tests, such as manual differentials, do not have specific Quality Control material and are "controlled" through technologist comparison and review of patient data. Where control materials are available, they should be carefully evaluated before use:
1. Commercial vs. patient
2. Similarity to that being tested, cost, stability
3. Concentration / levels
4. Controls vs. standards

Control testing may be implemented such as:
1. Random testing throughout the shift
2. Fixed testing (same time each day)
3. Random duplicates (patient split samples)

To know the 12 CLSI Quality Systems Essentials
COMMUNICATOR

The resident will be encouraged and expected, on a one-to-one basis, to collaborate and communicate with the technical staff and the supervisor on a daily basis.

The resident will be encouraged and expected to give input into the Quality Assurance provision in labs.

To be familiar with the principles for writing standard operating procedures for laboratory policies, process description, procedures and forms.

COLLABORATOR

The resident will consult with the medical staff regarding the clinical significance of quality assurance findings.

LEADER

Quality Control rules refer to rules applied to patient results, rules applied to running the Quality Control material and rules applied to results from control samples. For this discussion, Quality Control rules refer to rules governing results from control samples.

Quality Control rules are applied during and after analyses, and are designed to detect errors through bias and imprecision. Since errors can be random, consistent, or progressive, Quality Control rules usually involve:
1. Target values and limits (Gaussian statistics)
2. Westgard, multirule (representation of Quality Control rules)
3. Use of increased number of controls
4. Criteria for rule violations
5. Action to be taken

Control rules must be applied before reporting patient data.

Demonstrate approach to incidences using root cause analysis, including
1. fishbone diagram
2. matrix diagram
3. fault tree analysis
4. the 5 “whys”

Leadership role in managing QC for the laboratory
SCHOLAR

Documentation is primarily a representation of results and usually involves:
1. Charts, graphs (Levy-Jennings, Bland-Altman difference plots)
2. Equipment logsheets
3. Computer printouts
4. Record of problems and actions

Quality Control records should be reviewed weekly and monthly with the Supervisor and/or hematologist and appropriate action taken and documented.

Types of quality programs needed

In-House
The “backbone” of Quality Control, the in-house Quality Control program, involves known parameters and provides prompt results. It does not provide any information on how the laboratory is performing in relation to other laboratories.

Commercial
The commercial Quality Control program is similar to the in-house program in that the parameters tested how known values. The advantage of a commercial Quality Control program over the in-house program is that it provides an inter-laboratory comparison. The main disadvantage is the delay in receiving results.

Inter-Laboratory
An inter-laboratory Quality Control program is usually set up as an informal exchange between laboratories. It provides advantages to both in-house and commercial program, but the types of tests are usually limited. This program is not feasible where laboratories are too far apart.

The theory of lab management
1. Case development, work flow and staffing changes.
2. HR issues and funding issues.

COMPETENCY CHARACTERISTICS

By the end of the rotation the resident should have:
1. knowledge of the principles and procedures of quality assurance methods.
2. knowledge of specimen requirements and handling for various tests currently in use in the lab.
3. an understanding of how quality assurance methods are applied to clinical medicine.
4. an understanding of what information is required by the clinicians and how to interpret the results generated in the lab.
5. knowledge of the role of proficiency testing/external quality assessment in total quality management, and reviews
EVALUATION
Oral and/or written examination/seminar.
Other Tasks to complete:
1. ELMs learning online modules:
   a) WHMIS (Workplace Hazardous Materials Information System)
   b) Patient Safety
   c) Privacy and Information Security
   d) Workplace Violence and Harassment
2. Audit or other QA project

Required Reading:

   Chapter 10. Flow Cytometric Specimen Collection, Processing, and Reporting.
   Chapter 11. Validation and Quality Control in Clinical Flow Cytometry.
   Chapter 31 Sample Collection and Processing in Hemostasis.
   Chapter 55. Hematology Quality Practices.

References:

4. Implementing Quality Assurance Paul Bozzo ASCP webpage ISBN 0891892907
YEAR FOUR

Hematological Pathology
Program Rotations

4 weeks  Pediatric Hematology Laboratory, senior rotation
4 weeks  Lymph nodes/Lymphoma pathology
4 weeks  Hemoglobinopathy
16 weeks  Morphology
8 weeks  Transfusion Medicine
8 weeks  Elective or pre-exam study block
8 weeks  Research
First Week – General Haematology

- Introduction to the Haematology/TM lab at CHEO.
- Familiarization with CBC analyzers and Coagulation analyzers.
- CSF and body fluid processing and analysis.
- General morphology of peripheral blood and marrow in paediatric population.
- ESR, malaria testing, Monospot testing
- Familiarization with age appropriate normal ranges and values

Second Week – Special Haematology

- Osmotic fragility, G-6PD qualitative and quantitative testing, immunostaining, Heinz body preps.
- Haemoglobinopathy investigation – HPLC and IEF, H prep, sickle solubility test.
- Neutrophil function tests (NBT testing)
- Bone marrow aspirate processing – special stains.

Third Week – Transfusion Medicine

- Familiarization with paediatric and neonatal transfusion protocols.
- Processing and manipulation of blood products.
- Policy and procedures related to paediatric transfusion.

Fourth Week – Coagulation and Review

- Routine coagulation testing.
- Inhibitor testing.
- Review of rotation.
- Exit examination.

GENERAL OBJECTIVES

The general objectives of the Senior Paediatric Haematology/TM laboratory rotation is to provide the resident with the appropriate knowledge and skills to handle and interpret diagnostic tests for children and newborns with hematological and oncological disorders. These knowledge and skills will attain consultant’s level of expertise by the completion of the senior Paediatric Laboratory rotation.

The resident is expected to:

1. Know the common Haematology and Oncology disorders of children and newborns. These pathologies are unique for this age and illustrate important genetic, growth, developmental and environmental predispositions.
2. Be aware of the technical problems and requirements pertinent to Haematology tests and procedures for children. Know the appropriate set-up of laboratory diagnostic and transfusion services for these children, e.g. blood procurement, test manuals using minimal blood volume and sedation for bone marrow and lumbar puncture, transfusion procedures for children and newborns.

3. Learn the skills for evaluation, interpretation and reporting of Haematology diagnostic testing for common Haematology and Oncology disorders in children and newborns.

4. Recognize the importance of the collaboration in the ‘comprehensive care team’ practices in a children’s hospital and the vital roles played by the Hematology laboratory and transfusion services.

MEDICAL EXPERT/LEADER

Demonstrate effective utilization of laboratory testing and its interpretation. Demonstrate laboratory skills including:

**General Hematology**
- Understand the physiology of the different cells in the peripheral blood – white blood cells, red blood cells and platelets. Be familiar with the inherited and acquired disorders that can affect the different cells lines and be able to describe how the laboratory can aid in their diagnosis.
- Basic knowledge of the current haematology and coagulation analyzers and how they function. Knowledge of quality assurance principles.
- Complete blood count (CBC); normal and abnormal. Be able to describe how the various parameters on a CBC are calculated/measured including MCHC, MCV and RDW. Know the different situations where these parameters may be useful in diagnosis.
- Variation for age/sex (e.g. premature infants).
- Familiarization with normal paediatric peripheral blood morphology, and appreciation of the spectrum of normal.
- Recognition of abnormal peripheral blood morphology and the ability to incorporate this into the diagnosis and care of a patient.
- Use morphology for differential diagnosis.
- CSF and body fluid cell morphologies. Understand how a CSF/body fluid cell count is performed.
- Become familiar with the laboratory diagnosis of leukemias and how the Haematopathologist is required to incorporate test results from various laboratories into a concise report.
- Knowledge of the current leukemia protocols and how the Haematology lab plays a role (Day 8, 15, and 29 marrows for evaluation of response).

To understand how laboratory information is used to prognosticate and guide treatment in malignant haematology.
Knowledge of the following:
- How an ESR is performed.
- Reticulocytes measurements.
- Sickle Cell Screen.
- Infectious Mononucleosis Screen.
- Malaria screen and investigation, and reporting protocol
- Ability to recognize and triage situations where investigations need to be expedited.

**Bone Marrow**
- Understand the bone marrow microenvironment and the physiology of haematopoiesis.
- Familiarization with normal and abnormal bone marrow morphology. Be able to interpret bone marrow morphology and incorporate findings into a diagnosis for the patient.
- Be able to subclassify the leukemias according to the WHO classification.
- Be able to evaluate a marrow for evidence of metastatic disease.
- Be able to order the appropriate supplemental tests in the diagnosis of haematopoietic disorders.
- Basic knowledge of the other laboratory techniques that are useful in the diagnosis of haematopoietic disorders (i.e. histochemical stains, cytogenetics, molecular genetics, and immunophenotyping)

**Special Hematology**
- Investigation of haemoglobinopathies: Be familiar with the common techniques: HPLC, IEF, hemoglobin electrophoresis and molecular analysis. Understand the rationale behind the newborn screening program for haemoglobinopathies. Be able to interpret results of testing. Understand the complexity of the hemoglobin molecule and the interaction of the various haemoglobinopathies on the clinical spectrum of disease.
- Red Cell enzyme assays – Be able to describe the major metabolic pathways in the red blood cell and how perturbations result in the various hemolytic anemias. Knowledge of routine testing for enzyme deficiencies.
- Neutrophil function tests.

**Coagulation Tests**
- Knowledge of the coagulation cascade and the fibrinolytic pathways.
- Knowledge of developmental hemostasis.
- Coagulation screening tests: PT, PTT, fibrinogen, FDP.
- Hemophilia investigation, factor assays/inhibitors, molecular genetic studies. Be able to incorporate laboratory results into clinical management decisions.
- Von Willebrand’s disease investigation, molecular genetic studies. Be able to subclassify Von Willebrand's disease.
- DIC work-up.
- Monitor anticoagulants/therapy
Immunohematology (Paediatrics)

- Knowledge of routine pre-transfusion testing: ABO/Rh typing, antibody screening, and X-matching – micro-cross matching system (Ortho-MTS system).
- Direct and indirect anti human globulin testing. Be able to interpret a +DAT and suggest a course of investigation.
- Antibody investigation and familiarization with the major blood group systems.
- Understand the process for investigation of NAIT and platelet antibody testing.
- Neonatal immune screen.
- Investigation of autoantibodies and the laboratory evaluation for autoimmune haemolytic anaemia.
- Investigation of transfusion reactions and their clinical management. Knowledge of the reporting system within Canada for adverse events in transfusion.
- Knowledge of methods of blood conservation.
- Learn appropriate neonatal and paediatric transfusion practices. Understand how these differ in oncology patients and cardiac surgery.
- Knowledge of the risks of transfusion, both infectious and non-infectious.
- Familiarization with the different testing that is performed on blood products by Canadian Blood Services prior to release.
- Know the indications for different types of blood and blood products; irradiated blood, leukoreduced and CMV negative.
- Use of clotting factor concentrates – appropriate use and dosing. Rationale behind prophylaxis vs. on-demand treatment.
- Appropriate use of plasma derivatives.
- Become familiar with Lookback/Traceback investigative protocols

Learn the special requirements in testing for newborn and children.

- Blood procurement:
  - Micro sampling;
  - IV techniques / IV team.
  - Specialized collection tubes
- Appropriate laboratory instruments for children (using the minimum blood volumes). Impact that low volume requirements have on selection of laboratory equipment
- Organizing battery of tests for diagnosis to minimize specimen volume and avoid repeat sampling.
- Special laboratory requirements to support pediatric acute care services e.g., Emergency, NICU, ICU, Oncology, Cardiovascular Surgery.
- Special laboratory services to support specialized care programs e.g., chemotherapy, hemophilia, hemoglobinopathy and cardiac surgery.
- Computerized information system for order entry, result reporting, archive result, data retrieving and quality assurance analysis.
- Aware of the general principles and regulations on safety of laboratory and transfusion practices in children.
Skills
Demonstrate the ability to perform the following technical skills:
- Intravenous access and blood drawing;
- Slide making – peripheral blood and bone marrow slides.
- Sample procurement – bone marrow aspirate and biopsy collection (optional).

COMMUNICATOR/COLLABORATOR

The Haematology and TM lab at CHEO works closely with the clinicians in The Division of Hematology / Oncology and other subspecialties within the hospital. Due to the nature of paediatric oncology, most of the patients that are evaluated are on study, and close interaction between the laboratory, researchers and clinicians is vital.

Further skills that will be developed during this rotation include:

- Consult effectively with other physicians and health care professionals. Be able to advise colleagues about appropriate testing in the management of patients. Be able to incorporate both clinical and laboratory assessments into patient care.
- Contribute effectively to other interdisciplinary team activities.
- Consult and collaborate with physicians and other health care professionals and contribute effectively to interdisciplinary team activities within and between hospitals, other health care facilities, and collaborative groups.
- Be able to assimilate information from different laboratories into a concise report for the clinical staff (i.e. marrow morphology with Immunophenotyping results).

LEADER

- Utilize resources effectively to balance patient care, lifelong learning needs and personal activities.

- Demonstrate knowledge and the definition and role of audits, budget reviews, quality improvement, risk management, knowledge of adverse effects/incident reporting, and complaint management in hospital and ambulatory settings.
- Demonstrate an understanding of the social, societal and governmental aspects of health care provision in the pediatric hematology/oncology population.

HEALTH ADVOCATE

- Recognize and respond to those issues where advocacy is appropriate.
SCHOLAR

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, housestaff/students, and other health care professionals (e.g. laboratory technologists).
- Contribute to the development of new knowledge.
- The resident is expected to organize and give a presentation to laboratory staff during their rotation on a topic related to paediatric laboratory medicine.
- The resident will also give several informal presentations to the attending Haematopathologist on relevant topics.

PROFESSIONAL

- Deliver highest quality health care with integrity, honesty and compassion.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practice medicine ethically consistent with the obligations of a physician

ROUNDS

The following rounds are held on a regular basis at CHEO.  Attendance is not mandatory, but encouraged.  Highlighted rounds are particularly relevant. A current schedule is available upon request.

- Hematology/oncology team rounds - Weekly;
- **Hematology/Oncology Tumor Board** - Bi-weekly and ad hoc;
- Hematology/Oncology Journal Club – Monthly;
- Dept. of Pediatrics Grand Rounds - Weekly ;
- **Paediatric Haematology Half-Day Teaching** - Weekly ;
- Morphology Rounds with Paediatric Haematology Residents – Monthly.
EVALUATION

Dr. Leung will complete evaluations at the completion of the rotation. The trainee is expected to give a formal presentation to the laboratory staff regarding a relevant paediatric laboratory medicine topic. Evaluations will be done on this. An exit exam consisting of both written and practical component will be administered at the end of the four week rotation.

REFERENCE MATERIALS

16. Pizzo/Poplak – Pediatric Hematological Malignancies, CHEO Library
17. Pui – Childhood Leukemias
18. Andrew, et al. – Thromboembolic Complications during Infancy and Childhood
19. Lanzkowsky – Manual of Pediatric Hematology and Oncology
21. AABB Press – Pediatric Transfusion., Lab Copy
22. WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues. 2008.
25. Penchansky – Pediatric Bone Marrow
26. Bain – Haemoglobinopathy Diagnosis

APPENDIX I – For Reference Use

List of Hematological and Oncological Disorders that the Resident Should be Familiar with:

Haematologic Disorders of Newborns:

<table>
<thead>
<tr>
<th>Common Pediatric Hematological Disorders:</th>
<th>Red Cell Membrane Defects:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Anemia – Congenital</td>
<td>• Congenital Spherocytosis</td>
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<tr>
<td>• Bone Marrow Failure Syndromes:</td>
<td></td>
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<tr>
<td>• Fanconi Anemia</td>
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<td>• Diamond Blackfan</td>
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<td>• SDS</td>
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<td>• Severe Congenital Neutropenia</td>
<td></td>
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<tr>
<td>• Radial Platelet syndrome (TAR)</td>
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</tbody>
</table>

Red Cell Enzyme Defects:                                      Hemoglobinopathy:

| Glucose – 6 phosphate dehydrogenase deficiency | Thalassemia |
| Pyruvate Kinase deficiency                     | Hemoglobin Variants |
Anemia – Acquired:
- Nutritional Iron deficiency
- Hemolytic Uraemic syndrome
- Microangiopathy
- Hypersplenism
- Idiopathic Aplastic Anemia
- Auto Immune Hemolytic Anemia

Leukocyte disorders:
- Neutropenia: congenital and acquired
- Neutrophil function defects
- Use of GCSF
- Chronic Granulomatous disease
- Leukocytosis – Sepsis
- Leukaemoid reactions

Platelet Disorders:
- Thrombocytopenia
- Immunological (ITP)
- MYH9 disorders
- WAS
- Bernard-Soulier and Glanzmann’s
- Granule Defects
- Chediak-Higashi

Coagulation Defects.

Congenital:
- Hemophilia A/B
- Von Willebrand’s disease
- Thrombocytopenia
- Anti Thrombin III and Protein C/S
- Thrombophilia

Acquired:
- Vitamin K disorders/liver disease
- Anticoagulant overdose
- Disseminated intra-vascular coagulopathy (DIC)
Common Pediatric Malignancies:

- Acute leukemia:
  - Lymphoblastic
  - Myelogenous
- Myelodysplastic syndromes
- Brain tumours
- Wilms tumour
- Lymphomas/Hodgkins disease
- Neuroblastoma
- Ewings sarcoma
- Primitive Neuroectodermal tumours (PNET)
- Rhabdomyosarcoma
- Osteogenic sarcoma
- Teratoma, Germ Cells
- Retinoblastoma
OUTLINE

Monday  09:00  Autopsy Rounds, if hematologic cases
        11:00  Attends pathology case presentation if hematologic
Thursday  08:00  Lymphoma Rounds
Thursday  15:30  Morphology Rounds
Friday   12:00  Clinical Hematology Rounds

SPECIFIC OBJECTIVES

At the completion of training, the resident will have acquired the following competencies and will function effectively as:

MEDICAL EXPERT/CLINICAL DECISION-MAKER

General Requirements
1. Demonstrate sound knowledge of WHO lymphoma classification.
2. Demonstrate diagnostic skills for accurate diagnosis of lymphoproliferative disorders in a variety of organs.
3. Access and apply relevant information to clinical practice.
4. Demonstrate effective consultation services with respect to referred in consultation cases.

Specific Requirements
1. Demonstrate knowledge of normal anatomy, physiology and immunology of the lymphatic/immune system.
2. Demonstrate understanding of the general principles of embryologic development and the commoner variations of normal lymph nodes, spleen, thymus and bone marrow.
3. Demonstrate a superior and detailed knowledge of the normal gross and light microscopic appearance of lymph nodes, spleen and other lymphoid tissues.
4. Understand the basic principles of cell biology, immunology and pathogenesis, and the changes that occur in specific lymphomas.
5. Be familiar with the CD classification of lymphocyte antigens and their application to immunophenotyping of lymphoproliferative disorders.
6. Understand the principles of immunohistochemical diagnosis in malignant and inflammatory conditions.
7. Understand the principles of tissue processing and the use of different fixatives in the laboratory.
8. Demonstrate an in-depth knowledge of the appropriate processing and sampling of biopsy specimens for suspected lymphoma.
9. Understand the principles of nucleic acid-based molecular biology techniques and be familiar with their application to diagnosis in lymphoma diagnosis, especially the role of PCR and Southern blotting in gene rearrangement, lineage and specific translocation studies.

10. Understand the overall approach to examining a lymphoid organ microscopically, formulating a differential diagnosis based on histologic features and proceeding with the selection of confirmatory immunophenotyping.

11. Be familiar with the WHO classification of lymphoproliferative disorders and their clinical significance.

12. Understand the diagnostic pitfalls in interpreting biopsy tissues, including sample size, fixation problems, etc.

13. Demonstrate ability to take satisfactory gross and microscopic photographs of lymphoid tissues, including digital presentations of individual cases for teaching purposes.

COMMUNICATOR

General Requirements
1. Discuss cases with other members of the health care team in terms of diagnosis and prognosis.

Specific Requirements
1. Assist in the continuing education of physicians and other members of the hospital staff by participating in educational/clinical review forums such as lymphoma rounds.
2. Act as consultants to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
3. Understand the information a pathology report should provide in a given clinical situation and be able to communicate it effectively in an oral and written form.

COLLABORATOR

General Requirements
1. Consult effectively with other physicians and health care professionals.
2. Contribute effectively to other interdisciplinary team activities.
3. Understand the role of the pathologist as “gate-keeper” in patients entering clinical trials

Specific Requirements
1. Must have experience in clinical medicine and surgery sufficient to achieve a sound understanding of the effects of disease and the role of pathology in its management.
2. Demonstrate the ability to advise on the appropriateness of obtaining histologic and cytologic specimens and following examination of these, to advise on further appropriate investigations.
LEADER

**General Requirements**
1. Utilize resources of the pathology laboratory effectively to achieve an accurate diagnosis.
2. Allocate finite health care resources wisely.
3. Work effectively and efficiently in a health care organization.
4. Utilize information technology to optimize patient care, life-long learning and other activities.

**Specific Requirements**
1. Demonstrate knowledge of the methods of quality control in the laboratory as it relates to flow cytometry and immunohistochemistry of lymphoproliferative disorders.

HEALTH CARE ADVOCATE

**General Requirements**
1. Identify the important determinants of lymphoma pathogenesis and diagnosis.

**Specific Requirements**
1. As members of an interdisciplinary team of professionals responsible for individual and population health care, the anatomical pathologist will endeavour to help in informing the public about issues surrounding the diagnosis of lymphomas and risk factors for their development.

SCHOLAR

**General Requirements**
1. Develop, implement and monitor a personal continuing education strategy with respect to continuing education in lymphoma pathology.
2. Critically appraise sources of medical information and recognize the current best sources for lymphoma research reporting.
3. Facilitate learning of patients, house staff/students and other health professionals at rounds.
4. Contribute to development of new knowledge.

**Specific Requirements**
1. A small research project or case report should be discussed with the rotation supervisor at the beginning of the elective. This could be presented at any one of a number of forums ranging from lymphoma rounds to national meetings.
PROFESSIONAL

General Requirements

1. Deliver highest quality care with integrity, honesty and compassion.
2. Exhibit appropriate personal and interpersonal professional behaviours.
3. Practice medicine ethically consistent with obligations of a physician.
4. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

1. Act as an appropriate role model for students and others.
2. Demonstrate a professional attitude to colleagues, as well as to other laboratory staff.
3. Have an appreciation of the crucial role of the anatomical pathologist in providing quality patient care. This will include knowledge of individual professional limitations and the necessity of seeking appropriate second opinions.

KNOWLEDGE

1. Shall recognize tumors of lymphoid tissue and the main reactive condition of lymph nodes. Produce reports of these and signs them out with staff pathologist.
2. Correlates flow cytometry and DNA studies with morphologic findings and produces clinically relevant reports.
WEEKLY SCHEDULE/OBJECTIVES
The hemoglobinopathy rotation will be done both at CHEO and at The Ottawa Hospital, General Campus. Both laboratories perform hemoglobinopathy investigations, but the patient population is quite different at each site; residents will benefit from reviewing cases from both sites. The resident will coordinate with Drs. Leung and Saidenberg how best to divide their time between CHEO and The Ottawa Hospital, General Campus, to obtain the most benefit from this rotation. The trainee is expected to interpret all the haemoglobinopathy gel runs at both CHEO and The Ottawa Hospital, and to review these results with staff hematopathologists. The resident is expected to give a seminar presentation during the rotation. The resident will meet with Dr. Padmore at the end of weeks one and two, to go over the self-assessment questions from Chapter 8 in the textbook by Barbara Bain: “Haemoglobinopathy Diagnosis.”

During the second year, the resident did an introductory rotation in Hemoglobinopathies. This third year senior rotation is designed to review the material from the first year and increase the resident’s knowledge base in hemoglobinopathies. Residents will take on a more senior role and be expected to triage all investigations as well as partake in EQA challenges.

Week 1 - Review of laboratory techniques used in haemoglobinopathy investigation. Review of basic physiology and pathophysiology as it pertains to the haemoglobinopathies.
Week 2 – Review of the thalassemic syndromes (α thalassemia, β thalassemia,) and common hemoglobin variants (Hb S, C, E, D, O-Arab).
Week 3 - Paediatric Focus (see appendix 3)
Week 4 - Screening methods and aims. Familiarization with rare variants (HbMs, low oxygen affinity Hb, etc.) (see appendix 4).

There is the possible option of a 1 or 2 week elective at the Regional Hemoglobinopathy Genetics Laboratory in Hamilton, Ontario.

OBJECTIVES

MEDICAL EXPERT
- To understand the physiology of the hemoglobin molecule
- To understand the underlying pathophysiology of thalassemias and variant haemoglobins. To be able to describe the difference in the types of mutations between alpha-thalassemia and beta-thalassemia (large deletions vs. point mutations) and the implication on diagnostic testing.
- To learn to recognize hemoglobinopathies from peripheral blood indices and morphology.
- To review and observe the various laboratory techniques used to diagnose the hemoglobinopathies.
• To have a basic understanding of the molecular technologies used in the diagnosis of the haemoglobinopathies.
• To learn the specifics of hemoglobin electrophoresis, HPLC and Isoelectric focusing.
• To understand the clinical implications of the haemoglobinopathies.
• To have a good understanding of the current management of the sickling disorders, including transfusion related implications.
• To have an organized approach to the diagnosis and investigation of the haemoglobinopathies as outlined in recent practice guidelines.
• To have experience investigating rare variants or non-routine cases.

COMMUNICATOR

1. Reviews and reports all haemoglobinopathy studies
2. Teaches through rounds and one-on-one sessions with the laboratory staff, as confidence is gained through the rotation.
3. Brings gleaned knowledge from the literature back to the laboratory staff on diagnostically challenging cases.
4. Be able to recommend further testing to referring services as warranted.

COLLABORATOR

1. Reviews low MCV cases in lab, consults with other laboratory medicine specialists and selects cases for haemoglobinopathy investigation.

LEADER

1. Develops skill in working closely with laboratory technical staff.

HEALTH CARE ADVOCATE

1. Makes selection of cases for further diagnostic testing.
2. Responds positively to interpretive possibilities during the rotation to improve patient health.
3. Be familiar with the principles of prenatal/antenatal/neonatal screening programs and their impact on population health.
SCHOLAR

1. Shall prepare a rounds presentation during the rotation thus contributing to the education of other residents and the laboratory technologists on hemoglobinopathies. The topic will be decided after consultation with the supervising faculty.
2. Shall review the medical literature, make use of the library resources as available to review difficult cases.

PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in Hemoglobinopathies.
2. Shall respond promptly and helpfully to requests for assistance.
3. Shall work effectively and collaboratively with laboratory staff.

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:

- Have refreshed skills in hemoglobinopathies
- Be able to interpret all haemoglobinopathy investigations. Be able to suggest a course of investigation for non-routine cases.

EVALUATION

1. Successful completion of the self-assessment cases and completion of the questions as required in the appendices.
2. Evaluation of seminar presentation.
Appendix 1

**Week 1** Review of laboratory techniques used in haemoglobinopathy investigation. Review of basic physiology and pathophysiology as it pertains to the haemoglobinopathies.

1. Shall review hemoglobin genetics and structure.
2. Shall review expression and inheritance of Hb and changes noted with age.
3. Shall review smears for morphology (normal and abnormal hemoglobinopathies).
4. Shall review slides of thalassemia cases (minor, major, hydrops fetalis).
5. Shall review HB H inclusion morphology, distinguish from artifact and reticulocytes.
6. Shall review how samples are chosen for haemoglobinopathy testing.
7. Shall prepare hemolysate, and run alkaline and acid electrophoresis, IEF.
8. Shall review Hb separation methods. Shall review isoelectric focusing, HPLC and hemoglobin electrophoresis testing principles.
10. Shall review location of sickle band on alkaline gel, acid gel, isoelectric gel, Variant II (HPLC).
11. Shall understand the significance of Hb S interactions with other variant Hb.
12. Shall review pathophysiology of low MCV, and lab test methods to distinguish between iron deficiency, anemia of chronic disease and thalassemia syndromes.
13. Shall review diagnostic tests for thalassemia syndromes. Shall be aware of the differences in the types of mutations between alpha thalassemia and beta thalassemia (gap mutations vs. point mutations) and the implication for diagnosis.
14. Shall perform HB A2 and F quantitation using HPLC (Variant). Shall appreciate the normal increase noted in Hb F levels during the first year of life.
15. Shall perform calculation for fetal Hb containing cells.
16. Be able to interpret both straightforward and complex haemoglobinopathy investigations.
17. Familiarity with molecular testing as it pertains to haemoglobinopathy evaluations.
18. Review and report all haemoglobinopathy studies.

**Required reading:** Bain, Chapters 1, 2, and 4, Bain, chapter 8: self-assessment cases 8.- 2, 8, 10, 14, 15. Review on Bain CD, hemoglobinopathies: hematologist: questions 1 – 29.
Appendix 2

**Week 2** Review of the thalassemic syndromes (\(\alpha\) thalassemia, \(\beta\) thalassemia and common hemoglobin variants (Hb S, C, E, D, O-Arab).

**Required reading:**

Read Bain: Chapters 3, 5.
Do Bain, chapter 8: self-assessment cases 8. – 3, 4, 5, 7, 9, 11, 12, 18, 19, 21, 22, 23, 24.
Review Bain CD: hemoglobinopathies: hematologist: questions 33 - 51

Appendix 3

**Week 3 Paediatric Focus**

1. Prenatal/Antenatal screening.
2. Ontario Newborn Screening Program.
3. Review of interesting paediatric cases.
4. Shall appreciate the limitations/challenges of haemoglobinopathy testing in the paediatric population.

Appendix 4

**Week 4 Screening methods and aims. Familiarization with rare variants (HbMs, low oxygen affinity Hb, etc.)**

1. Review algorithms for screening in the following circumstances: Prenatal/Antenatal, Neonatal, Lab generated, low MCV testing.
2. Shall understand the process and rationale behind newborn screening for the haemoglobinopathies. Be able to investigate a positive screen result appropriately.
4. Perform calculation for fetal Hb using Kleihauer assay
5. Review low MCV cases in lab for checking that week and select cases for haemoglobinopathy testing
6. Review of rare variants and interesting cases, including HbMs, low oxygen affinity Hb, Hb Quebec-CHORI, Hb C-Harlem.
Recommended Textbooks/References

OBJECTIVES
This rotation is designed to augment the morphology learned throughout the preceding years. It will allow the resident to be comfortable with being the consultant to the technologists and the hospital. The resident will be capable of interpreting disorders of red cells, white cells, platelets as well as bone marrow aspirates and biopsies.

OUTLINE
Principles
1. Review techniques of making slides.
2. Review principles of stains used, their application and quality control
3. Review principles of special stains (cytochemistry)
4. Review possible artifacts in peripheral blood and bone marrow

Responsibilities
1. Daily responsibility for reviewing and reporting of abnormal slides of the day.
2. Daily responsibility for reviewing and reporting bone marrow aspirate and biopsies

Expectations:
The resident is expected to spend most of the day in the multihead microscope room, Room 3882, to be readily available for review of peripheral blood and bone marrow slides with the hematopathology staff and clinical hematologists. It is the responsibility of the resident each day to summarize the clinical history and review the peripheral blood films, body fluid slides and bone marrows.
For graded responsibility:
- The resident will review and write comments on all PB/body fluid slides independently. For routine PB/body fluid cases, the resident will do final sign out. The resident will bring all challenging PB/body fluid cases to staff hematopathology for final sign out.
- The resident will review and write at least 60 marrow reports independently, and bring these marrows to staff hematopathologist for final sign out.

The resident is expected to do at least one presentation, either at leukemia rounds or academic half day on a topic in morphology.

MEDICAL EXPERT
Red cell morphology
1. Review red blood cell maturation and criteria for morphologic interpretation of hypochromasia and megaloblastic maturation with particular emphasis on the recognition and criteria for nuclear cytoplasmic dysynchrony.
2. Review the morphology and pathophysiology in hemolytic disorders.
3. Review the morphology and pathophysiology in hemoglobinopathies and thalassemias.
White cell morphology

1. Review the benign disorders of neutrophils
2. Review disorders of lymphocytes.
3. Review leukemias, morphologic, cytochemical and Immunophenotyping characteristics.

Platelets

1. Review morphology in thrombocytopenias and thrombocytosis.

Bone Marrow

1. Review procurement and preparation of bone marrow aspiration and biopsy.
2. Review and present the morphologic findings in Myelodysplastic syndromes

LEADER

1. Develops skill in working closely with laboratory technical staff

HEALTH CARE ADVOCATE

1. Makes selection of cases for further diagnostic testing
2. Responds positively to interpretive possibilities during the rotation to improve patient health

COLLABORATOR

1. Shall demonstrate ability to work within the healthcare team.

COMMUNICATOR

1. Shall communicate critical results to the clinical team in a timely manner.

SCHOLAR

4. Shall contribute to the education of other residents and the laboratory technologists, by reviewing cases with them at the multihead microscope.
5. Shall review the medical literature, making use of the library resources as available to review difficult cases.
6. Shall present a case at leukemia rounds, should the opportunity arise, or make another presentation.
PROFESSIONAL

1. Shall deliver the highest quality care by developing expertise in advanced morphology
2. Shall respond promptly and helpfully to requests for assistance
3. Shall work effectively and collaboratively with laboratory staff
4. Shall spend most of the day in the multihead microscope room, Room 3882, to be readily available for review of peripheral blood and bone marrow slides with the hematopathology staff and clinical hematologists.

COMPETENCY CHARACTERISTICS

By the end of the rotation, the resident should:
1. Have refreshed skills in peripheral blood and marrow
2. Be able to interpret all morphology requests

EVALUATION

1. Successful participation in weekly morphology quizzes.
2. Evaluation of leukemia rounds and/or morphology presentation at academic half day.
OUTLINE

Monday
08:30  Program Director's Rounds
09:15  Hemepath academic half day

Tuesday
08:00  Medical Grand Rounds

Thursday
08:00  Leukemia/Lymphoma Rounds
13:00  Thrombosis Rounds

Friday
11:30  Apheresis Rounds: OBDC Conference Room L2247
12:00  Clinical Hematology Rounds

The following processes will be followed:

1. Knowledge mapping
2. Rotation/training
3. Final examination

Week 1  Review of material covered in earlier rotations
Weeks 2-9  Medical Expert – Laboratory Bench Rotation
Week 10  Communicator/Collaborator
Week 11  Leader/Health Advocate
Week 1-12  Professional
Week 12  Consolidate knowledge
OBJECTIVES

Upon completion of the residency the graduate will be able to:
1. Demonstrate diagnostic and therapeutic skills to effectively and ethically provide medical supervision in the transfusion laboratory.
2. Access and apply relevant information and therapeutic options to laboratory and transfusion practice.
3. Demonstrate effective consultation in a wide variety of clinical settings
4. Demonstrate knowledge of legal and ethical issues related to transfusion medicine
5. Develop effective educational strategies
6. Demonstrate a knowledge of regulations, standards and QA/QM issues related to transfusion medicine
7. Communicate transfusion related issues clearly to other healthcare professionals
8. Collaborate on transfusion issues with multidisciplinary groups
9. Understand the fundamentals of transfusion laboratory management
10. Develop and complete a transfusion research project (if selected)
11. Identify with and practice an advocacy role in relation to transfusion practice
12. Understand and practice the accepted requirements of a transfusion medicine professional

MEDICAL EXPERT

Review of material covered in year 1 and 3 rotations.
Increased focus on quality issues and laboratory management in Transfusion Medicine

BLOOD CENTRE:
Blood donor – selection, donation and testing
Processing, storage and distribution of blood products

HOSPITAL LABORATORY:
Basic serological testing and interpretation
Specialty serological skills
Consultation/interpretive skills
Bench rotation: 8 weeks

Upon completion of the training the Resident will have comprehensive knowledge in:

**Week 1**
- Receiving and dispensing
- Inventory management
- Storage of blood/products
- Blood specimen receipt/acceptability
- Blood order cancellation guidelines
- Component preparation, e.g., washed cells, cryo, etc.

**Week 2**
- Routine testing
  - ABO/Rh, weak D, antibody screen tests
  - Resolution of grouping discrepancies, choice of blood for transfusion
  - Type & Screen
  - Compatibility testing – electronic, routine, emergency, urgent
  - Automated procedures in the transfusion laboratory
  - Type specific vs. Rh Negative
  - Re-cross following issue of Group O
  - Massive transfusion

**Week 3**
- Component therapy, measurement of component deficiencies
- Dilutional coagulopathies and bleeding diatheses
- Use of colloid, dextran, albumin and hetastarch
- Outcome of transfusion, expected change in hematological parameters
- Transfusion practices, mixing red cells and colloids, warming blood
- Filter use, rate of transfusion
- Adverse reactions including incompatible transfusion

**Week 4**
- Antibody investigations
  - Case histories,
  - Clinical background/presentation
  - Absorption/elution
  - Rare cell panels/LN2
  - Rare blood registry
- Transfusion reactions – investigation and diagnosis
- Overview of transfusion medicine information system

**Week 5**
- Transfusion Transmitted Disease Testing (HBV, HCV, HTLV, HIV)

**Week 6**
- Prenatal and neonatal testing
- Writing standard operating procedures
- Document control

**Week 7**
- Autologous, directed donation program
- Patient/Donor examination (with clinical hematologist)
- Donation of blood
- Fibrin Glue, Serum Tears

**Week 8**
- Total Quality Management
- Quality Control
- External quality assessment programs
- Standards and regulations
COMMUNICATOR

1. Will liaise with patients and families regarding single donor apheresis products and stem cell collection.
2. Communicate with nursing regarding transfusion reactions: treatment and reporting.

COLLABORATOR

1. Consult with other physicians and health care professionals regarding transfusion related problems.

LEADER

1. Will learn all management procedures required in a tertiary care hospital and prove effective in carrying out practice.

HEALTH ADVOCATE/LEADER

Upon completion of the training the Resident will be able to:
1. Assess time needed for medical interpretation/advice when:
   • Assessing donor suitability in various situations – allogeneic, autologous, directed
   • Reviewing abnormal laboratory data
   • Signing of reports
   • Collecting an autologous unit of blood
2. Develop a budget, with staff assignments for a hypothetical research project
3. Prepare a 1 month staff rotation schedule for the transfusion laboratory, comply with union guidelines
4. Explain the key features of the transfusion medicine computer system
5. Identify the basic concepts of statistical analysis and apply these to data from your research study.
6. Describe how transfusion medicine physicians can be an advocate, through specialty societies, community-based groups, etc., to improve the practice of transfusion medicine through blood conservation
PROFESSIONAL

Upon completion of the training the Residents will be able to:
1. Display attitudes commonly accepted as essential to professionalism
2. Recognize self-limitations, including those related to professional competence
3. Balance personal and professional roles and responsibilities and develop appropriate techniques for resolving strains conflicts
4. Comply with accepted practices of the profession and local institution
5. Describe physicians’ professional, legal and ethical codes
6. Recognize, analyze and develop approaches to resolving ethical issues related to transfusion medicine
7. Be aware of, and apply, relevant legislation (statutes, regulations, standards) pertaining to transfusion laboratory practice

RESEARCH/SCHOLAR

Upon completion of the training the Resident will be able to:
1. Prepare for approval a research project in transfusion medicine including:
   - conceptualization,
   - study design,
   - project work
   - data analysis
2. Complete the project within the approved time-frame, write-up and present the findings at an appropriate meeting
3. Prepare and implement a strategy for personal continuing education and identify:
   - How to access current literature related to transfusion medicine
   - The main scientific meetings associated with transfusion medicine
   - The MOCAMP process
4. Apply the principles of critical appraisal to sources of medical information relating to transfusion medicine

CONSOLIDATE KNOWLEDGE

1. Personal study and review of rotation, presentation at rounds.

Final Exam

Final written examination and discussion of topics related to rotation.
REFERENCES

1. Transfusion
2. Transfusion Medicine
3. Vox Sanguinis
4. AABB Technical Manual
5. AABB Standards
6. Blood Transfusion in Clinical Medicine, Mollison, Engelfried, and Contreras.
OUTLINE

There will be an elective rotation in a discipline related to the practice of Hematopathology. The residency program committee will ensure that:

1. The elective period is planned prospectively by the program director and the resident
2. There is a clearly designated elective supervisor
3. The educational objectives of the elective are understood by the resident, the elective supervisor, and the program director
4. There is a well defined mechanism within the in-training evaluation system to include evaluation of the resident during the elective period. The mechanism for evaluation of the resident’s performance during the elective must be clearly understood beforehand by the resident, the elective supervisor, and the program director and be based on the education objectives of the elective
5. The evaluation of elective experiences is considered in the internal review of the program.

The elective program can be chosen from among those offered by any appropriate education or training environment.

OBJECTIVES

1. Enhance understanding of medical practice.
2. To obtain perspective on adjunctive discipline.
3. To enrich education experience.

CanMEDS

We will incorporate the CanMEDS objectives to suit the elective chosen.
INTRODUCTION

This rotation is to provide residents with focused time to prepare for the written and oral/practical components of the Royal College specialty examinations in Hematological Pathology. The resident is off-service, but is expected to report to work unless otherwise directed by the program director, and will be supervised by Dr. Padmore, with assistance from the other members of the Division of Hematopathology and Transfusion Medicine.

OUTLINE

Eight weeks (Blocks 11 and 13), dedicated to focused exam prep before the written and oral/practical exams respectively.

ACTIVITIES

1. Academic Half-Day, Monday mornings
2. Exam review prep sessions (approximately 1.5 hours, once a week from Jan to June)

OBJECTIVES

1. Focuses on summarizing knowledge of Hematological Pathology in preparation for Royal College specialty examinations in Hematological Pathology

MEDICAL EXPERT

1. Demonstrates basic and discipline specific knowledge with clinical correlates as applied to Hematological Pathology
2. Demonstrates soundness of judgment in the practice of Hematological Pathology
3. Demonstrates self-assessment capability

COMMUNICATOR

1. Demonstrates skill in presentation when and as needed
2. Demonstrates skill set to record and report with accuracy

COLLABORATOR

1. Demonstrates ability to work effectively in a team environment
2. Demonstrates ability to effectively consult with staff members

LEADER

1. Effectively utilizes resources, including effective time management
HEALTH CARE ADVOCATE

1. Demonstrates knowledge of issues of public health policies

SCHOLAR

1. Demonstrates knowledge of current practices in Hematological Pathology including recent advances

PROFESSIONAL

1. Recognizes limitations and seeks advice when needed
INTRODUCTION

A laboratory based research project related to the field of Hematopathology will be carried out. It will be initiated within a 3 month period at the beginning of the fourth year rotation and may, depending on the nature of the project be continued beyond that time.

OUTLINE

Twelve weeks of time dedicated to a suitable research project which may involve “wet lab” experience.

OBJECTIVES

2. To assist in the design and development of a research project.
3. To learn to plan for the realization of a project.
4. To ensure that the project is carried out in a timely fashion with adequate capture of data.
5. To appropriately analyze and interpret the data.
6. To prepare appropriate data for oral and/or written presentation.

MEDICAL EXPERT

4. Assess and apply relevant information to project.
5. Show judgment in developing proposal for project.

COMMUNICATOR

3. Will present results of study at rounds and appropriate scientific meetings.
4. Will demonstrate ability to communicate information to others.

COLLABORATOR

3. Will work with others, as appropriate, to carry out research project and achieve objectives.

LEADER

2. Utilize resources effectively to accomplish goals of project
3. Utilize information technology to obtain and process information data.
HEALTH CARE ADVOCATE

2. Recognize and deal appropriately with any issues surrounding informed consent and or patient sampling.

SCHOLAR

2. Critically assess scientific literature in order to develop project and assess significance of data.

PROFESSIONAL

2. Assess data with integrity and honesty.
3. Obtain ethics approval for any patient-based studies.