Hematopathology Fellowship Program
Goals and Objectives

MODULES:

1. Introduction to Transfusion Medicine (4 weeks)
2. Advanced Transfusion Medicine
   a. Advanced Transfusion Medicine (2 weeks)
   b. Tissue Typing (1 week)
   c. Cellular Therapy Laboratory (1 week)
3. Bone Marrow Pathology (3 weeks) + Bone Marrow differential, technologist-based training (1 week)
4. General Hematology and PBS Morphology (3 weeks) + Hemoglobinopathies training (1 week)
5. Lymph Node Pathology (4 weeks)
6. Specialized Laboratories
   a. Special Coagulation (1 week)
   b. Flow Cytometry (1 week)
   c. Cancer Cytogenetics (1 week)
   d. Molecular Hematology (1 week)

Module 1: Introduction to Transfusion Medicine

The goal of the Transfusion Medicine rotation is to provide fellows/ residents with the knowledge and skill, within a comprehensive training experience, to understand the performance and interpretation of serologic testing as well as product manipulation and provision. The rotation focus is on the effective allocation of resources to provide optimal patient care through safe, appropriate transfusion therapy.

The rotation is divided into core training and enhanced training. The core session is suitable as a two week elective for residents from a wide range of medical fields. The enhanced session, of an additional two weeks, is designed for Hematology Fellows or other Fellows requiring extensive knowledge of Transfusion Medicine.

Core Training/ Initial knowledge assessment quiz

- Block 1: Blood Products/ knowledge assessment quiz
- Block 2: Basic Serology/ General Transfusion Practices / knowledge assessment quiz

Enhanced Training

- Block 3: Advanced Serology/ Detailed Transfusion Practices/ knowledge assessment quiz
- Block 4: Administrative Topics/ Hematopoietic Progenitor Cell lab/ knowledge assessment quiz

Learning Objectives during the core session:

- Familiarity with the Calgary Laboratory Services model of service and the services offered
- Understanding of blood components and clinical indications
- Understanding of plasma protein products and clinical indications
- Understanding of coagulation factor concentrates and clinical indications
- Knowledge of collection, testing and storage of blood donations by Canadian Blood Service
- Understanding of 'vein to vein' philosophy in transfusion medicine
- Understanding the Regional transfusion medicine policies and procedures
- Knowledge of the principles of serologic testing and interpretation
- Knowledge of the principles of fetal maternal investigation and haemolytic disease of the newborn
- Understanding the alternatives to homologous blood
- Understanding the mechanisms of adverse reactions and clinical interventions
- Knowledge of ethical and legal issues
- Knowledge of the quality systems in the transfusion medicine setting
- Knowledge of the activities of the transfusion safety office

Learning Objectives during the enhanced session:

- Understanding the policies and practices for transfusion support of patients with special transfusion requirements
- Knowledge of the blood groups systems
- Knowledge of red cell antigen/ antibody reactions
- Understanding advanced serologic testing and interpretation
- Knowledge of other testing performed in transfusion medicine
- Knowledge of automated testing
- Knowledge of the management of the transfusion medicine department
- Knowledge of the current issues in the field of transfusion medicine
- Introduction to the basics of apheresis and clinical applications
- Introduction to the Hematopoietic progenitor cell processing laboratory
- A daily 'clinical' consultation will be required – provided as a case study if clinical situation not available

Teaching sessions, including the tour of Canadian Blood Services, Calgary Centre, are informal presentations within the laboratory and are conducted by senior technologists or designate. Appropriate footwear (closed heel and toe) and clothing must be worn. Other personal protective equipment (gowns, gloves) must be worn as required.

Formal clinical discussions with laboratory physicians or clinicians, as well as other non-technical topics, are arranged in the office setting. Travel between lab facilities is required and rotation schedules will be adjusted to accommodate the operation of the department.

Please contact the person indicated under "Assigned to", if unable to attend a scheduled session during the rotation. Punctuality is expected.

Evaluations will be conducted in short quiz format. Base knowledge will be assessed and learning will be periodically evaluated during the rotation.

Final evaluation will include a compilation of comments from staff involved in the rotation will be provided to the department of anaesthesia. An evaluation of the rotation will be completed by each resident/ fellow and returned to the Transfusion Medicine Department Head.

Anaesthesia residents will present a short informal education session the Transfusion Medicine staff regarding some aspect of that field of medicine.

Clinical Hematology Fellows/ Pediatric Oncologists will be required to propose a research question relevant to Transfusion Medicine. This proposal will be presented in a short informal education session to the Transfusion Medicine staff at the end of the rotation.

At the completion of training, the participant will have acquired the following competencies and will function effectively in the following CanMEDS roles:

Medical expert/ Clinical decision-maker

- Demonstrate knowledge of the indications for blood component/ product therapy, alternatives to blood products and adverse reactions associated with transfusion
- Demonstrate understanding of antibody investigations, interpretation of test results and selection of blood components
- Demonstrate awareness of the regulations and standards that govern the field of transfusion medicine in Canada and other countries

Communicator

- Communicate effectively with medical colleagues, nursing personnel and patients regarding all aspects of transfusion medicine
- Assist in the continuing education of physicians and other members of the health care team with regards to the safety of the blood system and appropriate utilization of blood products.
- Establish effective working relationships with consulting physicians
- Be able to effectively discuss the appropriate transfusion support for optimal patient care

Collaborator

- Effectively participate as a member of the multi-disciplinary team to provide optimal patient care requiring transfusion therapy
- Act as a liaison between the transfusion service, the clinical departments and the blood collection agency

Manager

- Demonstrate understanding of the principles of laboratory management and administration as applied to a hospital transfusion service
- Demonstrate knowledge of policies for the effective and safe operation of the transfusion service
- Demonstrate knowledge of the application of quality systems with the laboratory
- Understand the importance of utilization reviews and audits

Health Advocate

- Educate the public and colleagues regarding the need for blood donors
- Advocate for appropriate utilization of blood products and alternatives
- Demonstrate knowledge of the alternatives to transfusion in order to make recommendations to clinical colleagues and patients
- Recognize the importance of informed consent and patient notification and advocate for compliance with clinical colleagues

Scholar

- Act as a educational resource to other health care professionals and patients
- Facilitate the learning of residents, students and allied health care professionals

Professional

- Consider all requests for blood products in an ethical and consistent manner
- Exhibit exemplary professional behaviour during interactions with patients, medical colleagues and allied health care professionals
- Follow up occurrences/ adverse reactions in a manner that is consistent and non-accusatory with a purpose of fact-finding and process improvement

Reference material available from Transfusion Medicine:

- bloody easy 2 (on-line learning module available)
- CBS Clinical Guide to Transfusion
- CBS Circular of Information
- CBS Buffy coat Production Method – Circular of Information
- Copy of Guide to Transfusion as found in CLS Guide to Services
- CHR Regional Nursing Policy and Procedure Manual
- CLS Transfusion Medicine Operational Policy Binder
- Current Journals:
    - Transfusion (aabb)
    - Vox Sanguinis, The International Journal of Transfusion Medicine
- In-house Presentations:
    - Review of Blood Products (2008)
    - Canadian Blood Services – Plasma Protein Products (2008)
    - Inventory Management (2007)
    - IUT and Exchange transfusion (2001)
    - Neonatal transfusion and Guidelines (2008)
- DVD (or individual VHS tape)
    - The Strange Case of Penny Allison
    - Blood 101 – Manufacturing Process
    - Transfusion Alternatives
    - Safe Transfusion Practices

Module 2: Advanced Transfusion Medicine

A. Advanced Transfusion Medicine

The goal of the Transfusion Medicine rotation is to provide fellows residents with the knowledge and skill, within a comprehensive training experience, to understand the performance and interpretation of serologic testing as well as product manipulation and provision. The rotation focus is on the effective allocation of resources to provide optimal patient care through safe, appropriate transfusion therapy.

The rotation is divided into core training and enhanced training. The core session is suitable as a two week elective, morning only for residents from a wide range of medical fields. The enhanced session, of an additional two weeks, is designed for Hematology Fellows or other Fellows requiring extensive knowledge of Transfusion Medicine. An advanced session of one week is available specifically for Hematology Fellows. The enhanced and advanced sessions are scheduled for the entire day; however the participant's availability may be limited by clinical demands.

Core Training/ Initial knowledge assessment quiz

- Block 1: Blood Products/ knowledge assessment quiz
- Block 2: Basic Serology/ General Transfusion Practices / knowledge assessment quiz

Enhanced Training

- Block 3: Advanced Serology/ Detailed Transfusion Practices/ knowledge assessment quiz
- Block 4: Administrative Topics/ Hematopoietic Progenitor Cell lab/ knowledge assessment quiz

Advanced Training

- Adverse reactions to blood products
- Transmissible diseases
- Blood component recall/ withdrawal
- Management of blood product inventory
- Specific massive transfusion situations: Exchange transfusion/ intrauterine transfusion
- Management of a transfusion service
- Current issues in Transfusion Medicine

Learning Objectives during the core session:

- Familiarity with the Calgary Laboratory Services model of service and the services offered
- Understanding of blood components and clinical indications
- Understanding of plasma protein products and clinical indications
- Understanding of coagulation factor concentrates and clinical indications
- Knowledge of collection, testing and storage of blood donations by Canadian Blood Service
- Understanding of 'vein to vein' philosophy in transfusion medicine
- Understanding the Regional transfusion medicine policies and procedures
- Knowledge of the principles of serologic testing and interpretation
- Knowledge of the principles of fetal maternal investigation and haemolytic disease of the newborn
- Understanding the alternatives to homologous blood
- Understanding the mechanisms of adverse reactions and clinical interventions
- Knowledge of ethical and legal issues
- Knowledge of the quality systems in the transfusion medicine setting
- Knowledge of the activities of the transfusion safety office

Learning Objectives during the enhanced session:

- Knowledge and application of the policies of Calgary Laboratory Services, Transfusion Medicine
- Understanding the policies and practices for transfusion support of patients with special transfusion requirements
- Knowledge of the blood groups systems
- Knowledge of red cell antigen/ antibody reactions
- Understanding advanced serologic testing and interpretation
- Knowledge of other testing performed in transfusion medicine
- Knowledge of automated testing
- Introduction to the basics of apheresis/ tissue typing and molecular Hematology as applied to Hematopoietic progenitor cell transplantation
- Introduction to the Hematopoietic progenitor cell processing laboratory
- A daily 'clinical' consultation will be required – provided as a case study if clinical situation not available

Learning Objectives during the advanced session:

- Advanced knowledge of transfusion reactions: identification, management and laboratory investigation
- Advanced knowledge of adverse reactions following transfusion of both components and plasma protein products
- Understand the blood component recall/ withdrawal process
- Knowledge of the management of the transfusion medicine department
- Knowledge of the current issues in the field of transfusion medicine
- Knowledge of clinical studies in which a transfusion service participates
- Understanding of the management of the blood product inventory during inventory shortages
- Advanced knowledge transfusion support for the management of hemolytic disease of the newborn.
- A daily 'clinical' consultation will be required – provided as a case study if clinical situation not available

Teaching sessions, including tour of Canadian Blood Services, Calgary Centre, are informal presentations within the laboratory and are conducted by senior technologists or designate. Appropriate footwear (closed heel and toe) and clothing must be worn. Other personal protective equipment (gowns, gloves) must be worn as required.

Formal clinical discussions with laboratory physicians or clinicians, as well as other non-technical topics, are arranged in the office setting. Travel between lab facilities is required and rotation schedules will be adjusted to accommodate the operation of the department.

Please contact the person indicated under "Assigned to", if unable to attend a scheduled session during the rotation. Punctuality is expected.

Evaluations will be conducted in short quiz format. Base knowledge will be assessed and learning will be periodically evaluated during the rotation.
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An evaluation of the rotation will be completed by each resident/ fellow and returned to the Transfusion Medicine Department Head.

Anaesthesia residents will present a short informal session the Transfusion Medicine staff regarding some aspect of that field of medicine.
Clinical Hematology Fellows/ Pediatric Oncologists will be required to propose a research question relevant to Transfusion Medicine. This proposal will be presented in a short informal session to the Transfusion Medicine at the end of the rotation.

At the completion of training, the participant will have acquired the following competencies and will function effectively in the following CanMEDS roles:

Medical expert/ Clinical decision-maker

- Demonstrate knowledge of the indications for blood component/ product therapy, alternatives to blood products and adverse reactions associated with transfusion
- Demonstrate understanding of antibody investigations, interpretation of test results and selection of blood components
- Demonstrate awareness of the regulations and standards that govern the field of transfusion medicine in Canada and other countries

Communicator

- Communicate effectively with medical colleagues, nursing personnel and patients regarding all aspects of transfusion medicine
- Assist in the continuing education of physicians and other members of the health care team with regards to the safety of the blood system and appropriate utilization of blood products.
- Establish effective working relationships with consulting physicians
- Be able to effectively discuss the appropriate transfusion support for optimal patient care

Collaborator

- Effectively participate as a member of the multi-disciplinary team to provide optimal patient care requiring transfusion therapy
- Act as a liaison between the transfusion service, the clinical departments and the blood collection agency

Manager

- Demonstrate understanding of the principles of laboratory management and administration as applied to a hospital transfusion service
- Demonstrate knowledge of policies for the effective and safe operation of the transfusion service
- Demonstrate knowledge of the application of quality systems with the laboratory
- Understand the importance of utilization reviews and audits

Health Advocate

- Educate the public and colleagues regarding the need for blood donors
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- DVD (or individual VHS tape)
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Blood 101 – Manufacturing Process

B. Tissue Typing

The CLS Tissue Typing Laboratory (TTL) was founded about 30 yeas ago to serve the transplant community in Southern Alberta. Tissue typing and cross matching between recipient serum and donor white cells ensures successful transplantation and prolonged kidney engraftment. In addition, tests for living related kidney donors and for other organs are done in the laboratory.

Bone-Marrow Transplantations cure Malignancies, various Leukemias and certain genetic disorders. A key element in successful transplants is to ensure tissue-typing identity between donor and recipient by accurate classification of the Histocompatibilty genes. The closer the genetic similarity between two individuals, the higher the chances of identical tissue typing and survival of a graft between them.

The tissue Typing laboratory at CLS performs testing for approximately 75 paediatric and adult bone marrow transplants per year and similar numbers of solid organ transplants. The task of genotyping the donors within the context of the family or donors in the international registries lies with the laboratory. The laboratory is internationally accredited by the American Society of Histocompatibility and Immunogenetics (ASHI) in the following areas:

HSC/BM Transplantation: Related and Unrelated Donor
Solid Organ Transplantation: Live and Deceased Donor
Transfusion Support
Testing for Non-Transplant Clinical Purposes
Serology Typing
Molecular Typing
Solid Phase Typing

In this one-week rotation, the resident will gain a clear understanding of technical aspects of Tissue Typing as it applies to transplantation with the emphasis on hematopoietic stem cell transplantation (HSCT). The resident will spend time in the laboratory observing specimen testing conducted in the above listed area of preparation. The resident will review laboratory procedures and will get acquainted with the quality assurance program adopted in the Tissue Typing Laboratory. The resident will review selected cases, plus current cases, with the Laboratory Director and/or Scientist.

SPECIFIC OBJECTIVES:

At the completion of each training week, the trainee will be familiar and will acquire understanding of the following competencies:

Medical Expert/Clinical decision-Maker competencies include:

The resident will have:

1. Understanding of the Human Leukocyte Antigens (HLA) System
2. Knowledge of the principles and technical aspects of Tissue Typing
3. Knowledge of the role of HLA in HSC and Solid Organ Transplantation
4. Learn how to integrate the results from different testing methods.
5. Understand the role of HLA in disease association.
6. Introduction to the comprehensive quality assurance systems in a clinical laboratory setting with emphasis on indicators of quality pertinent to a Tissue Typing Laboratory.
7. Introduction to some safety and management aspects in clinical laboratory setting.

Talks/lectures available on G drive:

1. Fellows MHC Lecture December 2008.ppt
2. Fellows Luminex Molecular Typing by Tepnel Life Match.ppt
3. Fellows Organ Rejection Lecture 01312008.ppt
4. Fellows HLA Haplotype matching: a New Paradigm in HCT.ppt
5. Fellows cytokine polymorphism in renal tx Il-10.ppt

Specific Objectives: Communicator:

General Requirements:

a. Establish effective working relationships with consulting hematologists/ oncologists/pathologists and surgeons.
b. Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
c. Listen and respond effectively.
d. Discuss in a timely fashion appropriate information with the health care team.

Specific Requirements:

a. Understand the role of a TTL Director
b. Act as a consultant to clinical colleagues on the interpretation and relevance of TTL findings, with particular regard to their significance in the management of the patient.
c. Act as a TTL technical supervisor and learn how to troubleshoot an assay.
d. Understand the role TTL findings should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
e. Assist in the continuing education of clinicians/pathologists and other members of the health care team.

Specific Objectives: Collaborator

General Requirements

a. Consult effectively with other pathologists/clinicians and health care professionals.
b. Contribute effectively to other interdisciplinary team activities.

Specific Requirements:

a. Must have experience in basic immunology, genetics, protein chemistry, and transplantation sufficient to achieve a sound understanding of the effects of disease and the role of pathology in clinical management.
b. Demonstrate knowledge of basic molecular biology methods (PCR, probe hybridization, etc)
c. Demonstrate knowledge of serological and flow cytometry methods.

d. Demonstrate knowledge of basic HLA nomenclature.
e. Demonstrate knowledge of normal anatomy and physiology of solid organs.
f. Demonstrate a basic knowledge of light microscopic appearance of cells.
g. Understand the basic principles of celluar rejection and humoral rejection of renal transplant.
h. Understand the adverse outcome of hematopoetic stem cell transplant (GVHD, Rejection, Infection, etc).
i. Understand the principles of immunohistochemicalchemical stains in solid organ transplant (Banff scoring)
j. Demonstrate the ability to integrate the different histocompatibility testing results and correlate them with other pathologies and chemistry measures.

Specific Objectives: Manager

General Requirements:

a. Possess basic knowledge of HR function.
b. Utilize resources effectively to balance patient care, turn around time, and educational/research needs.
c. Allocate finite health care resources wisely.
d. Work effectively and efficiently in a health care organization.
e. Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements:

a. Demonstrate knowledge of the principles of laboratory management and administration.
b. Demonstrate knowledge of the methods of quality assurance and quality control in histocompatibility.
c. Demonstrate knowledge of accreditation needs and external proficiency requirement.
d. Demonstrate competence in basic computer skills with emphasis on web based HLA resources, automated electronic reporting, electronic communication, and search strategies.

Specific requirements: Health Advocate

General Requirements:

a. Contribute to optimal outcome of replacement therapy by providing the patient with the latest methods of histocompatibility and immunogenetics laboratory testing.
b. Recognize and respond to those issues where advocacy is appropriate.
c. Understand the role of a TTL director in patient's care

Specific Requirements:

a. As members of an interdisciplinary team of professionals responsible for individual and population health care, the TTL director will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these community needs.
b. Reinforce to the public and to the profession the essential contribution of laboratory medicine health.

Specific requirements: Scholar

General Requirements:

a. Develop, implement and monitor a personal continuing education strategy.
b. Critically appraise sources of medical information.
c. Facilitate learning of patients, house staff/students and other health professionals.
d. Contribute to development of new knowledge.

Specific Requirements:

a. The fellow/residents are expected to attend available Histocompatibilty teleconferences and transplant rounds.
b. The fellow/resident is expected to be able to propose a research question relevant to transplant immunology, transplant pathology and/or histocompatibility.

Specific requirements: Professional

General Requirement:

a. Deliver highest quality patient care.
b. Exhibit appropriate personal and interpersonal professional behaviours.
c. Practise medicine ethnically consistent with obligations of a physician.

Specific Requirements

a. Act as an appropriate role model for students and others.
b. Demonstrate a professional attitude to colleagues and other laboratory staff.
c. Understand individual professional limitations and the necessity of seeking appropriate second opinions.

Learning Outcomes:

At the end of this rotation a resident will be able to:

1. Possess a general understanding of the HLA system.
2. Request appropriate testing for HSC and Solid Organ Transplantation.
3. Make a decision regarding compatible and non-compatible HSC and Solid Organ Transplant
4. Understand Tissue Typing Laboratory reports.
5. Value the importance of QA systems in clinical testing
6. Understand the limitations of different Tissue Typing Methods and their quality controls.
7. Ability to construct and report by integrating results of different Tissue Typing methods.

Suggested reading:

The Tissue Typing Laboratory is involved with a variety of Histocompatibility and Immunogenetics testing methods and the reading requirement is vast, but must include selected reading from the following listed categories.

Tissue Typing Standards

- ABHI Statements of Competence for Histocompatibility Personnel, 1998
- ASHI Standards for Histocompatibility Testing, 2005
- UNOS Standards for Histocompatibility, 2005
- ASHI Laboratory Accreditation Inspection Checklist, 2005
- CAP Laboratory General Checklist, 2005
- CAP Histocompatibility Checklist, 2005

General Laboratory Skills and Safety

- OSHA Guidelines, Federal Register, 56 (No235): pp 64175-64182, 1991
- CMS CLIA Regulations, Federal Register, 68 (No16): pp 3639-3714, 2003
- *Laboratory Safety: Principles and Practices* (1995) Am Society Micro, Washington, DC
- *ASHI Laboratory Manual*, 4th Ed. 2001, updates 2005

Laboratory Management

- *Clinical Laboratory Medicine*, K. McClatchey (ed), Lippincott, Williams & Wilkins, 2001
- *Management: Theory, Process and Practice*, RM Hodgetts
- *Clinical Laboratory Management Review*. Bi-monthly from CLMA, Williams & Wilkins

Basic Immunology

- *Cellular and Molecular Immunology*, 5th Ed. A. Abbas (ed). Saunders 2005
- *Essential Immunology*, 6th Ed. Roitt, Brostoff & Male. Mosby 2001
- *Immunology: The Immune System in Health and Disease*, 6th Ed. C. Janeway (ed) Garland Publishing, 2004
- *The Immune System*. P. Parham, Garland Publishing, Elsevier Science, 2004
- *Illustrated Dictionary of Immunology*, JM Cruse & RE Lewis. CRC Press, 2002

Histocompatibility and Immunogenetics

- *HLA Facts Book*, Marsh, Parham, & Barber, Academic Press, 2005
- *HLA in Health and Disease* 2nd Ed., Academic Press, 2000
- *HLA Beyond Tears*, 2nd Ed. GE Rodey DeNovo, Inc. 2000
- *The HLA Dictionary 2004*, Schreuder, Hurley, Marsh, etal: Tissue Antigens (2005) 65,1-55; or Human Immunology (2005) 66,170-210; or International Journal of Immunogenetics (2005) 32,19-69.

Transplantation

- *Primer on Transplantation*, 2nd Ed. Norman & Suki, AST, 2001
- *Clinical Transplants*, published yearly 1988-present, Cecka & Terasaki, (eds) UCLA Tissue Typing Laboratory, Los Angeles, CA
- *Hemopoietic Cell Transplantation,* 3rd Ed. Thomas, Blume & Forman, Blackwell Science
- *Cord Blood Characteristics: Role in Stem Cell Transplantation.* Cohen, Gluckman, Rubinstein & Madrigal (eds). Blackwell Science, Inc. 2000

Flow Cytometry

- *Immunophenotyping*, Stewart & Nicholson (eds) Wiley-Liss, Inc, 2000
- *Flow Cytometry in Clinical Diagnosis.* Keren (ed) ASCP Press 3rd Ed, 2001
- *Practical Flow Cytometry,* 4th Ed. Shapiro (ed) Wiley-Liss, Inc. 2003

Molecular Biology

- *DNA: The Secret of Life.* Barry & Watson, Knopf Publishing, 2003.
- *Genes VIII*. Lewin, 8th Ed, Wiley & Sons, 2003.
- *PCR Technology*: *Current Innovations*, Library of Congress, Cataloging-in-Publication Data, 2nd Ed, 2003.
- *Molecular Biology of the Cell,* 4th Ed. Alberts, Garland Publishing, 2002.
- *Human Molecular Genetics,* 3rd Ed. Strachan, AP Read, 2003.
- *Molecular Typing 2000: A Technical Manual for Histocompatibility Laboratories,* SEOPF

C. Cellular Therapy

DEFINITION:

The CLS Cellular Therapy Laboratory (CTL) processes all products for paediatric and adult transplant performed by the Alberta Blood and Marrow Transplant Program (BMT Program). CTL, in conjunction with the Alberta BMT Program, is internationally accredited through the Foundation of Accreditation of Cellular Therapy (FACT). The Cellular Therapy Lab is in Clinical Section of Transfusion Medicine at Calgary Laboratory Services (Foothills Medical Centre).

Blood and marrow cell transplantations (commonly referred to as blood stem cell transplants) are employed to cure various malignancies and genetic disorders. CTL plays a critical central role by ensuring all products (peripheral blood stem cells, bone marrow, cord blood) used in the transplant are of ultimate quality and consistency.

GENERAL OBJECTIVES:

This one week long CTL module is designed to familiarize the trainee with the technical and theoretical aspects of blood and marrow transplant product processing, manipulation, and quality. The trainee will develop a clear and detailed understanding of the processing, manipulation, and quality control involved in the processing of transplant products. Learning tools will include direct observation and hands-on experience in product preparation/processing, quality control, clinical and quality indictor analysis, and overall quality assurance. The trainee will review selected product processing files, plus current products, with the Laboratory Director and/or MLT III. *At the completion of the module the trainee will be able to assess and recommend product processing procedures, interpret and utilize CTL product reports, and evaluate clinical and laboratory indicators of product quality.*

General Expectations:

1. Attendance at scheduled training & learning sessions.
2. Attendance at the weekly BMT clinical meeting.
3. Self study of relevant talks/lectures, papers, and texts.
4. Professional interaction with laboratory staff.
5. Participate in quality assurance activities in the lab.
6. Complete the end-of-module test.
7. Participate in module/preceptor evaluation.

Recommended Reading:

- *Hematopoietic Stem Cell Transplantation in Clinical Practice.* Ed. J. Treleaven and A. J. Barrett. Elsevier, Toronto 2009
- *Cellular Therapy: A Physician's Handbook*, 1st Edition. E. Snyder, MD and N.R. Hale, MD. AABB 2004
- *Cellular Therapy: Principles, Methods and Regulations.* Ed E, M. Areman & K. Loper, AABB 2009
- *Cord Blood: Biology, Immunology, Banking and Clinical Transplantation*. Ed. H.E. Broemeyer,. AABB 2011
- *FACT-JACIE International Standards, 5th Edition*. Foundation for Accreditation of Cellular Therapies, 2012. www.factwebsite.org
- *Hematopoietic Cell Transplantation,* 3rd Ed. Thomas, Blume & Forman, Blackwell Science 2004
- *Cord Blood Characteristics: Role in Stem Cell Transplantation.* Cohen, Gluckman, Rubinstein & Madrigal (eds). Blackwell Science, Inc. 2000
- *Essentials of Stem Cell Biology* 1st Ed. Lanza, Thomas, Thomson, Pedersen, Gearhart, Hogan, Melton, and West Eds. Academic Press, 2005.

SPECIFIC OBJECTIVES:

At the completion of the training week, the trainee will be familiar and will have acquired an understanding of the following competencies:

Medical Expert/Clinical Decision-Maker

General Requirements

- Demonstrate understand of the clinical relevance of Cellular Therapy Product (CTP) processing in human stem cell transplants
- Demonstrate ability to apply relevant information to clinical practice
- Demonstrate effective communication of product processing needs

Specific Requirements

- Demonstrate an understanding of the sources of hematopoietic stem/progenitor cells for transplant and their unique propertiesmonstrate knowledge of hematopoietic stem/progenitor cell biology
- Demonstrate an overall understanding of the principles and technical aspects of processing CTPs (Peripheral Blood Stem Cells (Apheresis), Bone Marrow, and Cord Blood)
- Display knowledge of the key quality indicators of CTPs and their impact on clinical outcome
- Appreciate the role of mesenchymal stem cells and other therapeutic cells in disease treatment
- Demonstrate ability to advise and consult on appropriate transfusion requirements for patients undergoing ABO/Rh incompatible allogeneic transplants
- Demonstrate ability to advise and consult necessary processing for autologous and allogeneic transplant products, including processing of ABO/RH incompatible products.
- Demonstrate ability to effectively order the collection, processing and infusion of CTPs.

Communicator

General Requirements:

- Establish effective working relationships with CTL staff, CTL Director and BMT Program partners
- Listen and respond effectively to concerns and needs of transplant partners
- Discuss appropriate information with the health care team

Specific Requirements:

- Understand the role of CTL in transplants
- Understand the role CTPs quality indicators play in clinical outcome
- Understand how effective and timely communication of adverse events and engraftment variances to CTL ensures ongoing quality and ultimate patient care
- Assist in the continuing education of other members of the health care team
- Communicate information regarding CTPs effectively with patients, medical colleagues, nursing and technical staff verbally and through written reports

Collaborator

General Requirements:

- Work effectively with BMT Program partners
- Contribute effectively to other interdisciplinary team activities

Specific Requirements:

- Experience in CTP processing is essential to achieve a sound understanding of the effects of CTP selection and processing on clinical management
- Demonstrate the ability to advise on the appropriateness of processing procedures, non-conforming product issues, and transfusion requirements for transplant patients

Manager

General Requirements:

- Utilize resources effectively to balance patient care, turnaround time, and **educational/research needs**
- Allocate finite health care resources wisely
- Work effectively and efficiently in a health care organization
- Utilize information technology to optimize patient care, life-long learning and other activities

Specific Requirements:

- Demonstrate knowledge of the principles of laboratory management and administration
- Demonstrate knowledge of the methods of quality control in CTL processing
- Demonstrate knowledge of the methods for quality assurance as applied to CTL Processing
- Demonstrate knowledge of national and international standards for CTP processing laboratories
- Demonstrate competence in basic computer skills with emphasis on electronic reporting, electronic communication and search strategies

Health Advocate

General Requirements:

- Contribute effectively to improved health of patients and communities
- Recognize and respond to those issues where advocacy is appropriate
- Understand the role CTL plays in patient's care

Specific Requirements:

- As members of an interdisciplinary team of professionals responsible for individual and population health care, the clinician will endeavour to ensure that laboratory practices are regularly evaluated to determine that they meet these community needs
- Reinforce to the public and to the profession the essential contribution of laboratory medicine health

Scholar

General Requirements:

- Develop, implement and monitor a personal continuing education strategy
- Critically appraise sources of medical information
- Facilitate learning of patients, house staff/students and other health professionals
- Contribute to development of new knowledge

Specific Requirements:

- Propose a research question relevant to CTP processing and/or CTP utilization in transplant

Professional

General Requirements:

- Deliver highest quality patient care
- Exhibit appropriate personal and interpersonal professional behaviours
- Practise medicine ethnically consistent with obligations of a physician
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity

Specific Requirements:

- Act as an appropriate role model for students and others
- Demonstrate a professional attitude to colleagues and other laboratory staff
- Have an appreciation of the crucial role CTL has in providing quality patient care
- Develop the necessary knowledge to understand limitations and the necessity of seeking appropriate second opinions

Module 3: Bone Marrow Pathology

At the completion of the rotation the clinical trainee is expected to be familiar with the indications for BM biopsy, will understand the methodology regarding slide preparation (push vs. squash), will comprehend the value of additional clinical and laboratory data in the final diagnosis provided to the clinicians, will be able to describe the microscopic findings and appreciate the value of ancillary techniques to the final diagnosis/sub-classification and will be able to suggest additional studies if required to facilitate the interpretation of BM biopsy material.

In addition, the pathology resident will be familiarized with expert, educational and legal aspects of the BM pathology practice. He/she will be able to differentiate various cellular elements of BM microenvironment. It is expected that this eight weeks long exposure limited to BM pathology will result in an adequate expertise to independently handle 75% of BM pathology service and appropriately differentiate/triage top 25% complex cases.

In addition, both clinical and pathology trainees will be able to appropriately interpret and utilize data extracted from case relevant research/review papers and will be encouraged to independently pose their own investigative questions/projects.

General expectations:

1. Daily evaluation of cases and designated rounds attendance.
2. Record/log of reviewed BM pathology cases with own and final diagnoses.
3. Residents are encouraged to make formal presentations at Clinical Hematology Tumor Rounds at TBCC.
4. Self study; regular daily review of teaching slides sets, CD ROM talks/lectures, relevant papers, etc available in the department.
5. Independently select clinically interesting/relevant cases for a review with the pathologist, in order to enhance one's specialty (Non- malignant pediatric cases / post transplant BM biopsies, infectious diseases etc) experience.
6. Writing end-of-rotation test, which will include short answer questions and pathology cases evaluation/differential diagnosis discussion (last Friday of the rotation).
7. Participate in module/preceptor evaluation.
8. Maximum one week long vacation/absences, which must be pre-approved by the hematopathology training co-ordinator prior to the start of the elective

SPECIFIC OBJECTIVES:

Medical Expert/Clinical decision-Maker competencies include:

By Week #1:

1. Demonstrates understanding of normal morphology of cells associated with BM microenvironment
2. Understands effective selection of representative slides for review.
3. Demonstrates knowledge of histology of a normal bone marrow structure, morphology and hematopoiesis.
4. For Aperio access, contact Tom Kryton to set up an account for you:

   Thomas Kryton
   Digital Imaging Specialist, Virtual Microscopy Lab
   403-220-8322
   Thomas.kryton@cls.ab.ca

Talks/lectures available on G drive:

1. Normal Histology of BM trephine
2. Diagnostic approaches to BM diagnosis

By Week #2

1. Comprehends value of ancillary techniques/data in interpretation of BM Biopsy
2. Understands the concept and distinct morphologic features of anemia, white cell disorders, platelet disorders, infectious diseases, and ancillary studies used in BM pathology.
3. Understands clinical and morphologic basis of a staging BM
4. Understands principles of diagnostic criteria to differentiate between reactive and neoplastic lymphoid aggregates.
5. Understands differential diagnosis of a ganulomatosis lesion in BM biopsy.
6. For Aperio access, contact Tom Kryton to set up an account for you.

Formal talks/lectures available on G drive:

1. Ancillary techniques in lymphoma and leukemia.
2. Transformation and molecular basis of cancer
3. Disorder of WBC.
4. Myeloproliferative Disorder (2008 WHO classification)

By Week #3

1. Demonstrate knowledge of spectrum of acute leukemia
2. Understand the principles of morphologic/immunohistochemical and cytogenetics principles of subclassification of acute leukemia, as per WHO classification.
3. Demonstrate knowledge of spectrum of application of ancillary techniques in the diagnostic subclassification of acute leukemia.
4. Understand the principles of morphologic/immunohistochemical and cytogenetic principles of factors in acute lymphoblastic leukemia and acute myeloid leukemia.
5. For Aperio access, contact Tom Kryton to set up an account for you.

By Week #4

1. Demonstrate knowledge of spectrum of myelodysplasia
2. Understand the principles of morphologic/immunohistochemical and cytogenetics principles of subclassification of myelodysplasia, as per WHO classification.
3. Understand the differential features among various types of MDS.
4. Demonstrate general understanding of international prognostic indication of MDS and various treatment modalities available for each subtype of MDS.
5. Understand the principles of morphologic/molecular and cytogenetics principles of sub-classification of myeloproliferative neoplasms, as per WHO classification.
6. For Aperio access, contact Tom Kryton to set up an account for you.

Formal talks are available:

i. Diagnosis and classifications of AML, AML, myelodysplastic syndromes and myeloproliferative neoplasms.
ii. Flow Cytometry, cytogenetic and cytochemical studies in the diagnosis of acute leukemia and other myeloid neoplasms.
iii. Myeloproliferative disorders: past, present and future.

SPECIFIC OBJECTIVES:

Communicator

General Requirements:

a. Establish effective working relationships with consulting haematologists/ oncologists/pathologists and surgeons.
b. Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
c. Listen and respond effectively.
d. Discuss in timely fashion appropriate information with the health care team.

Specific Requirements:

a. Understand the role of a pathology consultant
b. Act as a consultant to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
c. Understand the role pathologic findings should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
d. Assist in the continuing education of clinicians/pathologists and other members of the health care team.

Collaborator

General Requirements

a. Consult effectively with other pathologists/clinicians and health care professionals.
b. Contribute effectively to other interdisciplinary team activities.

Specific Requirements:

a. Must have experience in neoplastic hematopathology sufficient to achieve a sound understanding of the effects of disease and the role of pathology in clinical management.
b. Demonstrate the ability to advise on the appropriateness of obtaining histologic/ancillary techniques specimens and following examination of these, to advise on further appropriate investigations and management

Manager

General Requirements:

a. Utilize resources effectively to balance patient care, turn-around-time, and educational/research needs.
b. Allocate finite health care resources wisely.
c. Work effectively and efficiently in a health care organization.
d. Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

a. Demonstrate knowledge of the principles of laboratory management and administration.
b. Demonstrate knowledge of the methods of quality control in the field of neoplastic hematopathology.
c. Demonstrate knowledge of the methods for professional quality assurance as applied to other subspecialty laboratories like flow cytometry, molecular hematology and cytogenetics.
d. Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies.

Health Advocate

General Requirements:

a. Contribute effectively to improved health of patients and communities.
b. Recognize and respond to those issues where advocacy is appropriate.
c. Understand the role of consult pathology in patient's care

Specific Requirements:

a. As members of an interdisciplinary team of professionals responsible for individual and population health care, the consult pathologist will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these community needs.
b. Reinforce to the public and to the profession the essential contribution of laboratory medicine health.

Scholar

General Requirements:

a. Develop, implement and monitor a personal continuing education strategy.
b. Critically appraise sources of medical information.
c. Facilitate learning of patients, house staff/students and other health professionals.
d. Contribute to development of new knowledge.

Specific Requirements:

a. On completion of the rotation, the resident will be able to:
b. Propose a research question relevant to lymph node pathology.

Professional

General Requirement:

a. Deliver highest quality patient care.
b. Exhibit appropriate personal and interpersonal professional behaviours.
c. Practise medicine ethnically consistent with obligations of a physician.
d. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

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

Appendix:

Optional Clinical Training in Bone Marrow aspiration and Biopsy Procedure:

Goal: To gain skills; experience and competence in the clinical procedure of performing Bone Marrow aspiration and biopsy at the bedside for the diagnosis of Hematological disorders.

Supervisors: Dr. Karen Valentine; Director of Clinical Hematology fellowship program; will be the overall supervisor for this clinical training. Dr. Adnan Mansoor will assist with all the administrative issues and coordination. Clinical Hematology Faculty with University of Calgary and Calgary Health Region will be the preceptors.

Objectives:

1. Observe, learn and obtain "informed consent" from patient for the clinical procedure of Bone marrow aspiration and biopsy.
2. To observe, learn and skilfully apply various techniques used for local anesthesia for bone marrow aspiration/biopsy procedure.
3. To observe, learn and develop competency (independent or indirect supervision) in performing the bone marrow aspiration and biopsy procedure.
4. To understand and effectively execute the process of "triage" of various samples, required for submission of bone marrow sample for ancillary techniques.

Procedure:

1. Resident will coordinate with Hematology technologist at CLS laboratory (6th Floor FMC) to obtain the list of patients scheduled for the procedure.
2. Resident will accompany the Hematology technologist to the specific patient's bedside and will introduce him/her to physician responsible for the procedure.

3. Resident will observe the entire procedure quietly and attentively.
4. Resident will maintain a log sheet of the patients attended for acquiring the competency for this procedure (including observed; assisted, performed). Please use an extra patient sticker for this log sheet. Resident will also document the name and obtain signatures of the physician responsible for the specific procedure.

Module 4: General Hematology and PBS Morphology

Peripheral blood smear morphology is often the first line tests of a patient with haematological signs and symptoms. From these tests, most of the more specialized hematology tests follow. Remember that although the patient is not physically present, each laboratory request is a *bona fide* patient consultation,

Calgary Laboratory Services performs approximately 2,000 complete counts per day, of which the cell counter, according to present parameters, flags approximately 6% of the samples. A laboratory technologist then reviews the samples, with special attention to blood cell morphology. A laboratory technologist may then refer the smear to a hematopathologist, or it may comply with the criteria that are specified in the standard operating procedures for referral to a hematopathologist.

The general hematology rotation also includes exposure to screening of G-6PD and Pyruvate kinase deficiencies, Eosin-5-maleimide flow cytometry for hereditary spherocytosis, ESR and body fluid cytospin.

Objectives & Learning Outcomes (CANMED Guidelines):

Medical Expert/Clinical Decision Maker:

- Use correct terminology in description of cells and understand the clinical significance of morphologic findings and quantitative abnormalities
- Principles of current technology of cell counters
- Erythrocyte sedimentation rate
- Principles of cell staining
- Red cell morphology and clinical relevance, including red cell inclusions, thalassemia, haemolytic anemias and red cell enzymopathies
- Normal white blood cell morphology and development as well as reactive cell morphology
- Neoplasia of the lymphocyte lineage
- Neoplasia of the granulocyte lineage
- Granulocyte dysplasia
- Hereditary granulocyte and lymphocyte morphologic abnormalities
- Platelet abnormalities – hereditary and acquired
- Know the laboratory methods in the workup of haemolytic anemias, including membrane defects and enzyme deficiencies.

Communicator:

- Develops skills in application of clinical history for interpretation of PBS specimens from patients of varied ages and clinical settings.
- Gains experience in dealing with abnormal finding of PBS specimens.

- Communication with technical staff and the extent of information could be acquired from them.
- Communicates and shares insights with the multidisciplinary teams.

Collaborator:

- Collaborates with laboratory colleagues and other health care personnel.
- Collaborates with outside physicians for follow up and continued management.
- Collaborates in different clinical settings to optimize the diagnostic results.

Manager:

- Learns to manage a laboratory

Health Advocate:

- Learns to become an advocate to involve and improve the diagnostic achievements by laboratory methods.

Scholar:

- Research the subjects that are listed under medical expert/decision maker
- Is encouraged to review the literature on a topic of interest in order to give a presentation toward the end of the rotation.
- Learns about the structure of clinical laboratory, the value of laboratory results and laboratory research in the management of patients.

Professional:

- Conducts himself/herself in a professional manner, demonstrating respect for the confidentiality and dignity of patients and their families.
- Demonstrates knowledge of his/her limitations.
- Accepts guidance and supervision from members of the multidisciplinary team.
- Recognizes the ethical and legal issues related to clinical laboratory services.

Learning Outcomes:

At the end of this rotation the resident will understand:

Technology

- Know the principles of current technology of cell counters.
- Understand the principle and limitations of the erythrocyte sedimentation rate
- Peripheral blood cell morphology and quantitative changes
- Use correct terminology in description of cells and understand the clinical significance of morphologic findings and quantitative abnormalities
- Know red cell morphology and the clinical relevance of abnormal morphologic findings including red cell inclusions, thalassemia, haemolytic anemias and red cell enzymopathies
- Know normal white blood cell morphology and development as well as reactive cell morphology
- Identify and classify neoplasia of the lymphocyte lineage
- Identify and classify neoplasia of the granulocyte lineage
- Identify and describe granulocyte dysplasia

- Identify and describe hereditary granulocyte and lymphocyte morphologic abnormalities
- Identify hereditary and acquired platelet abnormalities
- Microorganisms and parasites in the blood
- Identify bacterial and parasitic infections
- Body fluids
- Understand the principle of cytocentrifuge
- Be able to identify neoplastic cells in fluids
- Hemolytic anemias and abnormalities of globin chain synthesis
- Have a general approach to investigate haemolytic anemias
- Know the principles of the tests for red cell membrane defects and red cell enzyme deficiencies

Library:

- Blood Cells: A Practical Guide, 4th Edition, by Barbara J. Bain
- Practical Hematology, 10th Edition, Lewis SM, Bain BJ, Bates L
- Color Atlas of Hematology, College of American Pathologists
- Color Atlas of Body Fluids, College of American Pathologists
- For Aperio Access, contact Tom Krypton to set up an account for you: Thomas Kryton
  Digital Imaging Specialist, Virtual Microscopy Lab
  (403) 220-8322
  Thomas.Kryton@cls.ab.ca

Hemoglobin Disorders

GENERAL OBJECTIVES:

The resident/fellow spends one week in the Special Hemotology Laboratory. It is based at the Foothills Medical Center, Calgary Laboratory Services. The emphasis of this rotation is on the appropriate workup of patients with hemoglobin disorder, interpretation of laboratory results, and clinical consultation.

General expectations:

1. Understand the genetics, biochemistry, and pathophysiology of hemoglobin disorders.
2. Become familiar with how hemoglobin tests are performed.
3. To know how to choose which hemoglobin testing methods are needed based on the patient's profile and laboratory data.
4. Exposure to molecular assays associated with hemoglobin disorder.

SPECIFIC OBJECTIVES:

At the completion of training week, the trainee will be familiar and will acquire understanding of the following competencies:

Medical Expert/Clinical decision-Maker competencies include:

1. Understand the decision making algorithm for screening of hemoglobinopathies
2. Understand the role of HPLC, hemoglobin gel electrophoresis and sickle cell screen in the workup of hemoglobinopathies

3. Understand when molecular analysis or genetic analysis for hemoglobinopathies are indicated
4. Demonstrate understanding of a role of consultative practice in hematopathology
5. Demonstrate understanding of the most common hemoglobin disorders

Communicator:

General Requirements:

- Establish effective working relationships with consulting physicians/hematologists.
- Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
- Listen and respond effectively.
- Discuss in timely fashion appropriate information with the health care team.

Specific Requirements:

- Understand the role of a hematopathology consultant.
- Act as a consultant to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
- Understand the role pathologic findings should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
- Assist in the continuing education of clinicians and other members of the health care team.

Collaborator

General Requirements:

- Consult effectively with other physicians and health care professionals.
- Contribute effectively to other interdisciplinary team activities.

Specific Requirements:

- Must have experience in hemoglobin disorders sufficient to achieve a sound understanding of the effects of disease and the role of pathology in clinical management.
- Demonstrate the ability to advice on further appropriate investigations and management.

Manager

General Requirements:

- Utilize resources effectively to balance patient care, turn-around-time and educational/research needs.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

- Demonstrate knowledge of the principles of laboratory management and administration.
- Demonstrate knowledge of the methods of quality control in the field of hemoglobin disorder.
- Demonstrate knowledge of the methods for professional quality assurance as applied to hemoglobin disorder.
- Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies.

Health Advocate

General Requirements:

- Contribute effectively to improved health of patients and communities.
- Recognize and respond to those issues where advocacy is appropriate.
- Understand the role of consult hematopathology in patient's care.

Specific Requirements:

- As members of an interdisciplinary team of professionals responsible for individual and population health care, the consult hematopathologist will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these communities' needs.
- Reinforce to the public and to the profession the essential contribution of laboratory medicine to health.

Scholar

General Requirements:

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, house staff/students and other health professionals.
- Contribute to development of new knowledge.

Professional

General Requirement:

- Deliver highest quality patient care.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practise medicine ethnically consistent with obligations of a physician.
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to special coagulation.

Specific Requirements

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

Learning outcomes:

At the end of this rotation the resident will understand:

- Know the principles of Hemoglobin gel electrophoresis, HPLC, sickle cell screen and molecular analysis for alpha thalassemias
- Understand the laboratory workup of hemoglobinopathies

SUGGESTED READING:

1. Color Atlas of hemoglobin disorders James D. Hoyer, MD, Steven H. kroft, MD, College of American Pathologists (CAP), 2003
2. Haemoglobinopathy Diagnosis Barbara J. Bain second edition 2006
3. Lecture available on CLS-G drive: Case studies on hemoglobin disorders

Module 5: Lymph Node Pathology

GENERAL OBJECTIVES:

The four week long Lymph Node module is designed to familiarize the trainee with the process of the lymph node/hematolymphoid mass biopsy, processing, evaluation and diagnostic assessment at the level of both primary and consultative/expert pathology practice, which comprehensively covers all aspects of patients care including: expert, education and legal matters.

At the completion of the rotation the clinical trainee is expected to be familiar with:

- indications for the LN biopsy
- distinction between the FNA, core biopsy and excisional biopsy
- distinct portions of the lymphoma protocol
- will be able to describe and interpret microscopic findings at the level appropriate for his/her training (graduate responsibility)
- value of ancillary techniques with respect to the final diagnosis/sub-classification.

At the Medical Expert level the trainee will be able to:

- differentiate the reactive, atypical and neoplastic hematolymphoid proliferations
- subclassify hematolymphoid neoplasms into 2008 WHO categories
- provide differential diagnoses at the level appropriate for his/her training
- appropriately utilize and interpret ancillary technique data
- research/review papers relevant to investigated cases
- independently pose own investigative questions/projects
- be familiarized with expert, educational and legal aspects of the consultative pathology practice

It is expected that this four weeks long exposure limited to LN pathology will result in an adequate expertise to independently handle 75% of service lymphoma cases and appropriately differentiate/triage top 25% complex cases. It is expected that the latter cases be handled at the level of a "pathology consultant" following appropriate consultative/referral practice/letters.

General expectations:

1. Daily evaluation of cases and designated rounds attendance.
2. Record/log of reviewed pathology cases with own and final diagnoses and choice of ancillary techniques.
3. Pager availability for daily lymphoma protocol cases at FMC and after hours/weekend cases at other Calgary Region Hospitals (arrange with techs/pathologists on call).
4. Preparation of at least two formal presentations at Clinical Haematology Tumour Rounds at TBCC.
5. Self-schedule two day long Molecular Pathology exposure with BobWinkfein, MPL Laboratory Scientist at 403.220.8667. Group scheduling with other residents rotating thru HP with you is encouraged
6. Self study; regular daily review of teaching slides sets, CD ROM talks/lectures, relevant papers, etc.
7. Independently select clinically interesting/relevant cases for a review with the pathologist, in order to enhance one's specialty (paediatric/CNS etc) experience
8. Writing end-of-rotation test, which will include two short answer questions and two pathology cases evaluation/differential diagnosis discussion (last Friday of the rotation).
9. Participate in module/preceptor evaluation.
10. Maximum one week long vacation/absences, which must be pre-approved by the hematopathology training co-ordinator prior to the start of the elective

SPECIFIC OBJECTIVES:

At the completion of each training week, the trainee will be familiar and will acquire understanding of the following competencies:

Medical Expert competencies include:

By Week #1

1. Demonstrate understanding of a role of consultative practice in surgical pathology.
2. Demonstrate understanding of all parts of a lymphoma protocol.
3. Effective selection and utilization of immunohistochemical markers.
4. Understands the principles of screening immunohistochemical panels.
5. Comprehends value of ancillary techniques/data and their utility in the diagnosis of malignant lymphoma
6. Demonstrates knowledge of histology of a normal lymph node and developmental pathways of hematopoetic cells.
7. Understands the concept and distinct morphologic features of various reactive lymphadenopathies.
8. For Aperio access, contact Tom Kryton to set up an account for you:

   Thomas Kryton
   Digital Imaging Specialist, Virtual Microscopy Lab
   403-220-8322
   Thomas.kryton@cls.ab.ca

Talks/lectures available on G drive:

1. Development of B/T lymphocytes.
2. Histology of a normal lymph node.
3. Reactive lymphadenopathies. .
4. Lymphoma protocol and ancillary techniques in the diagnosis of non-Hodgkin lymphoma
5. Flow cytometry: Applications in neoplastic hematopathology.

By Week #2

1. Demonstrates understanding of basis of WHO classification of tumours of hematopoietic and lymphoid tissues.
2. Understands clinical and morphologic basis of Hodgkin lymphoma diagnosis
3. Understands principles of diagnostic criteria and subclassification of Hodgkin Lymphoma
4. Understands differential diagnosis and mimickers of Hodgkin Lymphoma.
5. For Aperio access, contact Tom Kryton to set up an account for you.

Formal talks/lectures available on G drive:

1. Hodgkin lymphoma; diagnosis, subclassification and differential diagnosis.
2. WHO classification of tumours of hematolymphoid and lymphoid tissues. Dr. X. Jiang

By Week #3

1. Demonstrate knowledge of spectrum of mature clonal B-cell neoplasms.
2. Understand the principles of morphologic/immunohistochemical and cytogenetics principles of subclassification of mature clonal B-cell neoplasms, as per WHO classification.
3. Demonstrate knowledge of spectrum of mature aggressive B-cell non-Hodgkin lymphomas.
4. Understand the principles of morphologic/immunohistochemical and cytogenetic principles of subclassification of aggressive B cell neoplasms, as per WHO classification.
5. For Aperio access, contact Tom Kryton to set up an account for you:

Formal CD ROM talks/lectures available:

1. Mature small cell B-cell non-Hodgkin lymphomas
2. Diffuse Large B cell lymphoma

By Week #4

1. Demonstrate knowledge of spectrum of mature clonal T-cell neoplasms.
2. Understand the principles of morphologic/immunohistochemical and cytogenetics principles of subclassification of mature clonal T-cell neoplasms, as per WHO classification.
3. Understand the principles of morphologic/immunohistochemical and cytogenetic principles of subclassification of clinico-pathologically specific T/NK cell lymphomas, as per WHO classification.
4. Demonstrate general understanding of other hematopoietic disorders including: precursor B/T neoplasms, chronic myeloproliferative/myelodysplastic disorders, and acute myeloid leukemia/ myeloid sarcoma.
5. For Aperio access, contact Tom Kryton to set up an account for you.

Formal CD ROM talks/lectures:

1. T-cell and NK-cell neoplasms
2. An overview of haematopoietic disorders

Communicator

General Requirements:

- Establish effective working relationships with consulting hematologists/ oncologists/ pathologists and surgeons/ interventional radiologists
- Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
- Listen and respond effectively.
- Convey and discuss in timely fashion laboratory data with the appropriate members of the patient's health care team.

Specific Requirements:

- Understand the role of a primary pathologist and consultant pathologist
- Act as a consultant to both pathology/clinical peers on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
- Understand the role pathologic findings could provide in a given clinical situation; be able to communicate it effectively and in a timely fashion in an oral and written form with designated members of the patient's health team.

- Assist in the continuing education of clinicians/pathologists/trainees and other members of the health care team.

Collaborator

General Requirements
- Consult effectively with laboratory personnel and other pathologists/clinicians and health care professionals.
- Contribute effectively to interdisciplinary team activities
- Contribute to formal and informal research and innovation initiatives of the laboratory and clinical teams

Specific Requirements:
- Must have experience in neoplastic hematopathology sufficient to achieve a sound understanding of the effects of disease and the role of pathology in clinical management.
- Demonstrate the ability to advise on the appropriateness of obtaining histologic/ancillary techniques specimens and following examination of these, to advise on further appropriate investigations and management
- Demonstrate the ability to advise on formal and informal research and innovation initiatives of the laboratory and clinical teams

Manager

General Requirements:
- Utilize resources effectively to balance patient care, turn around time, and educational/research needs.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Utilize information technology to optimize and personalize patient care/prognosis, life-long learning and other activities.

Specific Requirements
- Demonstrate knowledge of the principles of laboratory management and administration.
- Demonstrate knowledge of the methods of quality control in the field of neoplastic hematopathology.
- Demonstrate knowledge of the methods for laboratory and professional quality assurance as applied to neoplastic hematopathology
- Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies.

Health Advocate

General Requirements:
- Contribute effectively to improved health of patients and communities.
- Recognize and respond to those issues where advocacy is appropriate.
- Understand the role of primary and consultative pathology service in patient's care

Specific Requirements:
- As members of an interdisciplinary team of professionals responsible for individual and population health care, the hematopathologist will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these community needs.
- Reinforce to the public and to the medical profession the essential contribution of laboratory medicine to the overall health care system.

Scholar

General Requirements:

- Develop, implement and monitor personal continuing education strategy/progress.
- Critically appraise sources of medical information.
- Facilitate learning of patients, laboratory personnel, medical students, post-graduate trainees and other health professionals.
- Contribute to development of new knowledge thru involvement in formal and informal research/innovation initiatives.

Specific Requirements:

- Able to search and appraise literature relevant to difficult pathology cases
- Be able to propose a research question relevant to lymph node pathology.

Professional

General Requirement:

- Deliver highest quality patient care.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practise medicine ethnically consistent with obligations of a physician.
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent in practice of hematopathology.

Specific Requirements

- Act as an appropriate role model for trainees and others.
- Demonstrate a professional attitude to colleagues and other laboratory staff.
- Have an appreciation of the crucial role of the pathologist in providing quality patient care.
- Knowledge of an individual professional limitations and the necessity of seeking appropriate second opinions.

Module 6: Specialized Laboratories

A. Special Coagulation

GENERAL OBJECTIVES:

The resident/fellow spends one week in the Special Coagulation Laboratory. It is based at the Diagnostic Science Center (DSC), Calgary Laboratory Services. The emphasis of this rotation is on the appropriate workup of patients with coagulation disorders, interpretation of laboratory results, and clinical consultation.

The resident/fellow obtains histories daily on all patients requiring interpretation of coagulation profiles. These patients are usually being evaluated for DIC, platelet dysfunction, abnormal pre-operative coagulation studies, possible lupus anticoagulants, recurrent thrombosis, generalized bleeding, von Willebrand's disease, hemophilia, other hereditary clotting factor deficiencies, or clotting inhibitors.

General expectations:

1. Become familiar with most clinical clotting problems and able to interpret abnormal findings.
2. Become familiar with how clinical coagulation tests are performed.
3. To know how to choose which coagulation testing methods are needed based on the patient's clinical profile.
4. Exposure to molecular assays associated with hypercoagulation.
5. Maintain current knowledge of the pathophysiology of coagulation disorders.

SPECIFIC OBJECTIVES:

At the completion of training, the trainee will be familiar and will acquire understanding of the following competencies:

Medical Expert/Clinical decision-Maker competencies include:

1. Demonstrate understanding of a role of consultative practice in hematopathology.
2. Demonstrate understanding of the most common coagulation disorders.
3. Demonstrate understanding of the concept of thrombophilia and thrombotic disorders.
4. Demonstrate understanding of the most common platelet disorders.
5. Understands clinical and laboratory diagnosis of anti-phospholipid antibodies/syndrome.
6. Understands principles of diagnostic criteria and classification of Von Willebrand disease.

Lectures available on CLS-G drive:

1. Introduction to hemostasis
2. Thrombophilia
3. Platelet aggregation test
4. Anti-phospholipid antibodies/ syndrome
5. Von Willebrand disease

Communicator:

General Requirements:

- Establish effective working relationships with consulting physicians/ hematologists.
- Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
- Listen and respond effectively.
- Discuss in a timely fashion appropriate information with the health care team.

Specific Requirements:

- Understand the role of a hematopathology consultant.
- Act as a consultant to clinical colleagues on the interpretation and relevance of pathological findings, with particular regard to their significance in the management of the patient.
- Understand the role pathologic findings should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
- Assist in the continuing education of clinicians and other members of the health care team.

Collaborator

General Requirements:

- Consult effectively with other physicians and health care professionals.
- Contribute effectively to other interdisciplinary team activities.

Specific Requirements:

- Must have experience in special coagulation haematology sufficient to achieve a sound understanding of the effects of disease and the role of pathology in clinical management.
- Demonstrate the ability to advice on further appropriate investigations and management.

Manager

General Requirements:

- Utilize resources effectively to balance patient care, turn around time and educational/research needs.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

- Demonstrate knowledge of the principles of laboratory management and administration.
- Demonstrate knowledge of the methods of quality control in the field of special coagulation haematology.
- Demonstrate knowledge of the methods for professional quality assurance as applied to special coagulation haematology.
- Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies.

Health Advocate

General Requirements:

- Contribute effectively to improved health of patients and communities.
- Recognize and respond to those issues where advocacy is appropriate.
- Understand the role of consult hematopathology in patient's care.

Specific Requirements:

- As members of an interdisciplinary team of professionals responsible for individual and population health care, the consult hematopathologist will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these communities' needs.
- Reinforce to the public and to the profession the essential contribution of laboratory medicine to health.

Scholar

General Requirements:

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, house staff/students and other health professionals.
- Contribute to development of new knowledge.

Professional

General Requirement:

- Deliver highest quality patient care.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practise medicine ethnically consistent with obligations of a physician.
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to special coagulation.

Specific Requirements

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

SUGGESTED READING:

Denise M, Harmening. Clinical Haematology and Fundamental of Hemostasis (4th ed.). F.A Vavis Company

Kandice Kottke-Marchat. An Algorithmic Approach to Hemostasis Testing CAP 2009

B. Flow Cytometry

GENERAL OBJECTIVES:

A week-long Flow Cytometry portion of the Specialized Laboratories module is designed to familiarize the trainee with the flow-cytometry based clinical testing. Flow cytometry constitutes a key element in the diagnosis/sub-classification and monitoring of various hematolymphoid disorders. Applications of immunophenotypic testing in the diagnosis/sub-classification of hematolymphoid disorders, detection of minimal residual disease (MRD), clinical management of BMT transplant and/or immunocompromised patient will be outlined through both technical and interpretive aspects/phase of immunophenotyping.

During **the technical phase** of the rotation the trainee will learn the principles of:

- flow cytometry instrumentation,
- sample processing,
- data analysis,
- selection of the appropriate staining panel is performed,
- limitations of the techniques as imposed by artefacts/suboptimal viability etc.

During **the interpretive phase** the trainee will learn to interpret the histogram plots, and under the supervision of the hematopathologist will correlate them with the clinical history and put in the context of morphologic findings (PB smears, BM biopsies, LN biopsies/touch preps,). Under the supervision of the pathologist preceptor, the trainee will review the daily assortment of cases which may include:

- pancytopenia and acute leukemia
- malignant lymphoma,
- minimal residual disease
- ploidy assessment

- other specialized testing including, but not limited to:
    - paroxysmal nocturnal hemoglobinuria,
    - fetal-maternal haemorrhage,
    - oxidative burst,
    - perforin assessment,
    - mitogen stimulation evaluation and
    - immunodeficiency disorder work-up

In addition, an independent, concurrent and systematic self-review of immunophenotypic features of reactive and neoplastic haematopoietic and lymphoid tissue tumours is expected during this rotation.

A well organized study set flow cytometric reports/talks and articles are available on a G drive to aid the trainee in this process.

General expectations:

1. Daily material review with the technologists and service hematopathologist
2. Designated rounds attendance.
3. Pager availability for stat lymphoma/leukemia cases
4. Self study; regular daily review of teaching slides, teaching sets, G drive with CD ROM talks/lectures, relevant papers, etc.
5. Pro-active selection of subspecialty relevant cases (pediatric/neuropathology) for a review with the hematopathologist to enhance one's specialty experience
6. Writing end-of-rotation test, which will include short answer questions and histogram/plot evaluation/ discussion (last Friday of the rotation).
7. Participate in module/preceptor evaluation.
8. No scheduled vacation/absences; any unforeseen absences must be communicated to the Hematopathology Program Training Co-ordinator and individual hematopathology preceptor.

SPECIFIC OBJECTIVES:

At the completion of the flow cytometry training the trainee will have adequate knowledge of principles and clinical application of flow-cytometric techniques in the diagnosis and management of patients with hematolymphoid disorders/malignancies.

The trainee will require understanding of the following competencies:

Medical Expert/Clinical decision-Maker

Understand the basic principles in flow-cytometry including:

- Sample selection and accessioning
- Cell yield and viability testing
- Staining panel selection
- Principles of surface antigen and intracellular antigen staining preparation
- Gating strategies
- Data acquisition and reporting
- Understand the lineage specificity and association of various fluorochrome tagged monoclonal antibodies used in a clinical flow-cytometry laboratory.

- Formulate panel of various antibodies to determine the lineage/immunophenotypic diagnosis of a hematolymphoid malignancy.
- Understand and interpret the dot plots and understand the lineage/ immunophenotype of a particular hematological malignancy (ie. B- T- NK-cell neoplasm, acute myeloid leukemia).
- Suggest some additional ancillary studies to refine and modify these observations in the light of clinical information or other data.

Communicator:

General Requirements:

- Establish effective working relationships with the case hematopathologist and consulting haematologists/oncologists/pathologists.
- Establish effective working relationships with laboratory technologists, laboratory scientist and supporting staff including clerks and administrative assistants.
- Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
- Listen and respond effectively.
- Discuss in timely fashion appropriate information with the health care team.

Specific Requirements:

- Understands the role of a flow cytometrist/hematopathology consultant within the health care team.
- Act as a consultant to clinical/laboratory colleagues on the interpretation and relevance of immunophenotypic findings, with particular regard to their significance in the management of the patient.
- Understand the role of flow cytometry findings should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
- Assist in the continuing education of clinicians/pathologists and other members of the health care team.

Collaborator:

General Requirements

- Consult effectively with other pathologists/clinicians and other health care professionals.
- Contribute effectively to interdisciplinary team activities.

Specific Requirements:

- Must have experience in neoplastic hematopathology sufficient to achieve a sound understanding of the effects/role of immunophenotypic analysis is in the diagnosis and clinical management.
- Demonstrate the ability to advise on the appropriateness of obtaining additional ancillary studies and following examination of these, to advise on further appropriate investigations and management

Manager:

General Requirements:

- Ability to utilize health care resources effectively to balance patient care, turn around time and educational/research needs.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Utilize information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

- Demonstrate knowledge of the principles of laboratory management and administration.
- Demonstrate knowledge of the methods of quality control and assurance in the field of immunophenotypic testing.
- Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies

Health Advocate

General Requirements:

- Contribute effectively to improved health of patients and communities.

Specific Requirement

- Recognize and respond to those issues where advocacy is appropriate i.e educate family practitioners, general surgeons, interventional radiologists regarding appropriateness of immunophenotypic testing and its limitations.
- Understand the role of immunophenotypic testing in primary and specialized care of patient with hematolymphoid disorder.

Scholar:

General Requirements:

- Effectively develop, implement and monitor a personal self-education strategy during this week-long rotation
- Critically appraise sources of medical information, as it pertains to clinical cases.
- Facilitate learning of faculty, fellow trainees, medical student-observerships, and other health professionals; i.e. laboratory technologists/nurses.

Specific Requirements:

- on completion of the rotation, the resident will be able to propose a real life/simulated research question relevant to immunophenotypic testing.
- Contribute to development of new knowledge by involvement in on-going or new/original reasearch project/s within the Flow Cytometry Laboratory

Professional:

General Requirement:

- Deliver highest quality patient care.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practise medicine ethnically consistent with obligations of a physician.
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

- Act as an appropriate role model for other trainees, students and laboratory personnel
- Demonstrate a professional attitude to peers, colleagues, laboratory and administrative staff.
- Have an appreciation of the crucial role of the hematopathologist in providing quality patient care. This will include knowledge of an individual professional limitations and the necessity of seeking appropriate second opinions.

Suggested Reading:

- Nguyen, D. (2003). Flow Cytometry in Hematopathology: A Visual Approach to Data Analysis and Interpretation. Totowa, NJ, U.S.A.: Humana Press Inc.
- Keren, D. (2001). Flow Cytometry in Clinical Diagnosis (3rd ed.). Chicago, Illinois, U.S.A.: American Society of Clinical Pathologist.
- Ortolani, C (2011). Flow Cytometry of Hematological Malignancies. Oxford, UK: Wiley-Blackwell.
- Ochs, H.D., Smith C.I.E., Puck, J.M. (2007). Primary Immunodeficiency Diseases: A Molecular and Genetic Approach. Oxford, UK: Oxford University Press.
- Geha, R., Rosen, F. (2008). Case Studies in Immunology: A Clinical Companion (5th ed.). NewYork, U.S.A.: Garland Science.
- Sun, T. (2008). Flow Cytometry and Immunohistochemistry for Hematologic Neoplasms. Philadelphia, PA, U.S.A.: Lippincott

C. Cancer Cytogenetics

GENERAL OBJECTIVES:

Objectives of Training

Definition

Cytogenetics is that branch of laboratory medicine concerned with the study of numerical and structural changes in the chromosome complement. Cancer cytogenetics specifically includes conventional chromosome analysis and fluorescence in situ hybridization (FISH) analysis of tissue suspected of having a hematolymphoid or other malignancy.

In this one-week rotation, the resident will gain a clear understanding of technical aspects of chromosome and FISH analysis, and the clinical application of results to haematopathology. The resident will spend time in the laboratory, interpret archival and current cytogenetic cases, and become familiar with sources of clinical cytogenetic information.

Specific Objectives

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

Medical Expert/Clinical Decision-maker:

General Requirements:

- Demonstrate diagnostic and therapeutic skills for ethical and effective patient care.
- Access and apply relevant information to clinical practice.
- Demonstrate effective consultation services with respect to patient care, education and legal opinions

Specific requirements:

- Demonstrate knowledge of the normal structure and function of chromosomes, and of the normal cell cycle.
- Demonstrate knowledge of the principles and technical aspects of chromosome and FISH preparation and analysis, including turnaround time and workload.
- Demonstrate knowledge of the limitations of cytogenetic and FISH analysis.
- Demonstrate understanding of quality control and quality assurance in cytogenetics.
- Demonstrate knowledge of the correlation between clinical, pathologic and cytogenetic information, and their impact on diagnosis and prognosis.
- Understand the importance of genetic information in the WHO classification of tumours of hematopoietic and lymphoid tissue.
- Demonstrate knowledge of appropriate specimens for cytogenetic and FISH analysis.
- Select appropriate FISH and other genetic tests to determine the diagnosis in a specific clinical situation.
- Recognize normal and abnormal karyotypes, and relate them to various disease states.
- Understand clinical cytogenetic reports.

Study Material Available:

1. Study questions and karyotype file.
2. Jaffe E.S. et al (2001) Pathology and Genetics. Tumours of Haematopoietic and Lymphoid Tissues. IARC Press.
3. Fletcher C.D.M et al (2002) Pathology and Genetics. Tumours of Soft Tissue and Bone. IARC Press. (for Pathology Residents)
4. Atlas of Genetics and Cytogenetics in Oncology and Haematology. http://atlasgeneticsoncology.org/

Communicator:

General Requirements:

- Establish effective working relationships with consulting physicians and surgeons.
- Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
- Listen and respond effectively.
- Discuss appropriate information with the health care team.

Specific Requirements:

- Understand the role of a cytogenetics consultant
- Act as a consultant to clinical/pathologic colleagues on the interpretation and relevance of cytogenetic findings, with particular regard to their significance in the diagnosis and management of the patient.
- Understand the role cytogenetic findings may provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in oral or written form.
- Assist in the continuing education of clinicians, pathologists and other members of the health care team.

Collaborator:

General Requirements

- Consult effectively with pathologists, clinicians and other health care professionals.
- Contribute effectively to interdisciplinary team activities.

Specific Requirements:

- Demonstrate the ability to advise on the appropriateness of obtaining specimens for cytogenetics/FISH; following examination of these, advise on further appropriate investigations and patient management.

Manager:

General Requirements:

- Use resources effectively to balance patient care, turn around time, and educational/research needs.
- Allocate finite health care resources wisely.
- Work effectively and efficiently in a health care organization.
- Use information technology to optimize patient care, life-long learning and other activities.

Specific Requirements

- Demonstrate knowledge of the principles of laboratory management and administration.
- Demonstrate knowledge of the methods of quality control in cytogenetics.
- Demonstrate knowledge of the methods of quality assurance in cytogenetics.
- Demonstrate competence in basic computer skills with emphasis on electronic communication and literature/database search strategies.

Health Advocate:

General Requirements:

- Contribute effectively to improved health of patients and communities.
- Recognize and respond to those issues where advocacy is appropriate.
- Understand the role of consult pathology and cytogenetics in patient's care

Specific Requirements:

- As members of an interdisciplinary team of professionals responsible for individual and population health care, the physician will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet community needs.
- Reinforce to the public and to the profession the essential contribution of laboratory medicine to health.

Scholar:

General Requirements:

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, house staff/students and other health professionals.
- Contribute to development of new knowledge.

Specific Requirements:

- Critically read cytogenetic literature related to hematopathology.
- Facilitate the cytogenetic learning of health professionals.

Professional:

General Requirements:

- Deliver highest quality patient care.
- Exhibit appropriate personal and interpersonal professional behaviours.
- Practise medicine ethnically consistent with obligations of a physician.
- Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to anatomical pathology.

Specific Requirements

- Act as an appropriate role model for students and others.
- Demonstrate a professional attitude to colleagues and other laboratory staff.
- Have an appreciation of the crucial roles of the pathologist and cytogeneticist in providing quality patient care.
- Demonstrate awareness of individual professional limitations and the necessity of seeking appropriate second opinions.

D. Molecular Hematology

General Objectives:

Molecular Hematology laboratory plays a key role in the diagnosis and management of various malignant and non-malignant disorders. This laboratory also provides critical information regarding the clinical management of bone marrow transplant patients. Trainees will have one week rotation in the laboratory to observe the molecular techniques currently being carried out in the laboratory that employ immunologic assays (ELISA, binding assays, Western blotting), or polymerase chain reaction (whole blood PCR, reverse transcription directed PCR, real-time PCR and inverse PCR) for: 1) detection of mutations and carrier determination in disorders of hemostasis and thrombosis, 2) the molecular detection and monitoring of abnormal fusion gene transcripts in leukemias, 3) detection of mutations in signalling proteins with prognostic value in AML, 4) JAK-2 mutations in chronic MPDs and 5) the determination of blood cell chimerism after bone marrow/PBSC transplantation. For those assays not currently running in the laboratory, the resident will review assay theory, procedures, and previous results with the laboratory director. This rotation will provide opportunity to have a broader understanding of technical aspects, clinical application, and appropriate use/ limitations of molecular techniques in the diagnosis and clinical management of various hematologic disorders.

The resident/fellow will also participate in a sign out session of Molecular Hematology. During this session a hematopathologist//hematologist and laboratory director will review all the molecular hematology results of the week. The clinical application, appropriate subsequent testing and advice to clinician will be discussed and the report will be finalized in the light of available clinical information and additional assay performed in various other laboratories.

General expectations:

1. Daily meeting with laboratory section head
2. Daily visit to molecular hematology laboratory and observation of advance molecular testing protocols

3. Participation in at least one molecular sign-out session with consulting hematopathologists
4. Self study, regular review of supplied review papers and powerpoint presentations or other publications/learning materials
5. Write a final quiz consisting of 25 multiple choice and short answer questions relating to molecular protocols and role of molecular testing in diagnosis and monitoring of hematologic disease
6. Participate in module preceptor evaluation

Specific Objectives:

At the conclusion of the training week, the trainee will be familiar with and will acquire an understanding of the following competencies:

Medical expert/Clinical decision-maker

General Requirements:

1. Demonstrate understanding of the value of molecular technologies in diagnosis and therapeutic monitoring of patients with hematologic diseases
2. Demonstrate a knowledge of principles of DNA and RNA based molecular assays
3. Demonstrate a knowledge of principles of advanced immunologic based assays

Specific Requirements:

1. Understand the concepts and distinct features of:
    a. von Willebrand disease and its classification by vWF multimer gel analysis
    b. inherited risk factors for thrombosis and corresponding clotting factor gene mutation/polymorphisms
    c. HITTS associated antibodies and their detection by immunologic and functional assays
    d. type 2N vWD vs. mild hemophilia A
    e. carrier determination in hemophilia A and B by immunologic (probabilistic) and gene mutation (direct) analyses.
    f. molecular abnormalities in leukemias and chronic myeloproliferative disorders such as PV, ET and IMF; and residual disease detection by molecular methods
    g. cell signalling pathway gene mutations as prognostic indicators in acute leukemias such as AML
    h. hematopoietic cell chimerism after BM/PBSC transplantation and its detection by PCR STR and real-time PCR InDel analyses
2. Awareness of appropriate use of molecular testing and ethical and medical/legal implications of molecular DNA screening assays in a family setting
3. Appreciate the important role of quality assurance in the molecular laboratory
4. Understand the limitations of molecular data

Communicator

General Requirements:

a. Establish effective working relationships with consulting hematologists/ oncologists/pathologists and staff in other specialized laboratories

b. Obtain and synthesize relevant clinical history from physicians, electronic and written health records.
c. Listen and respond effectively.
d. Discuss, in a timely fashion, appropriate information with the health care team.

Specific Requirements:

1. Understand the role of a pathology consultant with respect to molecular testing
2. Act as a consultant to clinical colleagues on the interpretation and relevance of molecular data, with particular regard to their significance in the management of the patient.
3. Understand the role molecular data should provide in a given clinical situation and be able to communicate it effectively and in a timely fashion in an oral and written form.
4. Assist in the continuing education of clinicians/pathologists and other members of the health care team particularly with respect to appropriate use/ordering of advanced molecular testing.

Collaborator

General Requirements:

1. Consult effectively with other hematopathologists/clinicians and health care professionals.
2. Contribute effectively to other interdisciplinary team activities including BMT group, adult and pediatric bleeding disorders clinics, and other CLS specialized laboratories.

Specific Requirements:

1. Must have sufficient exposure to advanced molecular methods and use/limitations of molecular data to achieve a sound understanding of the role of molecular technologies in clinical management.
2. Demonstrate the ability to advise on the appropriateness of molecular testing and following examination of these, to advise on further appropriate investigations and management
3. Understand and communicate effectively to other health professionals the medico/legal implications of gene based screening in a family or population based setting

Manager

General Requirements:

1. Utilize resources effectively to balance patient care, turn around time, and educational/research needs
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 principles of laboratory management and administration particularly with respect to operation of a molecular laboratory
2. Demonstrate knowledge of the methods of quality control in the field of molecular pathology, particularly with respect to PCR based methodologies
3. Demonstrate knowledge of the methods for professional quality assurance as applied to advanced immunologic and DNA/RNA based technologies and the role of external surveys, variance reporting/tracking and other QA programs
4. Demonstrate competence in basic computer skills with emphasis on automated electronic reporting, electronic communication and search strategies

Health Advocate

General Requirements:

1. Contribute effectively to improve the health of patients and communities
2. Recognize and respond to those issues where advocacy is appropriate
3. Understand the role of consult pathology in patient's care

Specific Requirements:

1. As members of an interdisciplinary team of professionals responsible for individual and population health care, the consult pathologist will endeavour to ensure that laboratory practices and test selection are regularly evaluated to determine that they meet these community needs
2. Reinforce to the public and to the profession the essential contribution of laboratory medicine to health

Scholar

General Requirements:

1. Develop, implement and monitor a personal continuing education strategy
2. Critically appraise sources of medical information
3. Facilitate learning of patients, house staff/students and other health professionals
4. Contribute to development of new knowledge

Specific Requirements:

1. Show proficiency in utilizing electronic access to medical literature in researching a given topic in molecular medicine and show familiarity with use of powerpoint or similar software for preparing a seminar presentation on that topic

Professional

General Requirements:

1. Deliver highest quality patient care
2. Exhibit appropriate personal and interpersonal professional behaviours
3. Practise medicine ethnically consistent with obligations of a physician
4. Demonstrate the knowledge, skills and attitudes relating to gender, culture, and ethnicity pertinent to molecular pathology

Specific Requirements:

1. Act as an appropriate role model for students and others
2. Demonstrate a professional attitude to colleagues and other laboratory staff
3. Have an appreciation of the crucial role of the pathologist in providing quality patient care including; knowledge of an individual professional limitations and the necessity of seeking appropriate second opinions/ opinions of specialists from other disciplines