

TRANSFUSION MEDICINE

GOALS AND OBJECTIVES

The transfusion medicine core rotation is designed to build upon the fundamental elements of diagnostic and therapeutic interventions within the VUMC blood bank. The fellow will strive to not only quickly and accurately assess immunohematology evaluations, but will also be called up to discuss, design, and implement novel diagnostic algorithms and technologies to ensure accurate and comprehensive patient care. Fellows will work to actively survey the blood utilization at both VUMC and VCH, including prospective blood management auditing, active participation in transfusion committees, and interdepartmental education.

THE FELLOW WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- The fellow will review all immunohematology evaluations, and guide the selection of additional testing and interventions
 - a. Critical results will be directly communicated to the appropriate clinical care team
 - b. The fellow will actively manage the inventory for highly alloimmunized patients (i.e. sickle cell disease), to ensure an adequate and evidence-based transfusion medicine strategy
 - i. The fellow will prospectively audit, calculate, and determine the evidence-based threshold for transfusion in highly alloimmunized patients
 - ii. The fellow will work with clinical chemistry reviewing red blood cell orders for these patient, ensuring HPLC and solubility tests are in accordance with blood ordering strategy
 - c. The fellow will compare and contrast the clinical results from activation of the massive transfusion protocol (MTP)
 - iii. The fellow will retrospectively analyze the appropriateness of the cycles used in the MTP
 - d. The fellow will survey the patients that have received out of group blood products and determine if further immunoprophylaxis is indicated
 - iv. The fellow will be able to calculate the appropriate dose for these interventions, understanding the risk/benefit ratio of the medication
 - e. The fellow will oversee all suspected transfusion reactions
 - v. The fellow should be able to guide the clinical team in regard to additional testing (i.e. chest x-ray, peripheral culture, UA, etc.)
 - vi. The fellow will work with the VUMC microbiology department to assess all suspected septic transfusion reactions (viral, bacterial, and parasite)
 - iii. The fellow will review gram stains on returned units for inspection of microorganisms
 - f. The fellow will ensure Rh discrepant pregnancies are actively evaluated for maternal-fetal blood screen
 - vii. The fellow will work with the VUMC flow cytometry laboratory when appropriate
 - viii. Based on appropriate results, the fellow will review calculated doses of RhIg
- The fellow will serve as an active team leader for both peripheral stem cell collections, as well as photopheresis (ECP) patients
 - a. See Apheresis rotation objectives

- The fellow will assist in the identification/evaluation of transfusion medicine cases based on laboratory parameters
 - a. The fellow will actively work as a member of the DMT Transfusion Medicine team to evaluate cases of suspected immune mediated hemolytic cases and other suspected transfusion reactions

MEDICAL KNOWLEDGE

- At the conclusion of the fellowship the fellow will have a command of:
 - a. Pre-transfusion laboratory testing
 - i. ABO/Rh
 - ii. Antibody screen
 - i. The fellow will be able to compare and contrast the limitations of various testing methodologies
 - iii. Antibody panels
 - i. The fellow will be able to work with medical technologists and SBBs to determine the most appropriate testing required for elucidation of suspected allo- and auto-antibodies
 - iv. Product labeling
 - i. The fellow will be able to discuss the strengths and weaknesses of currently available product labels
 - The fellow will be able to delineate the need for specialty labels for irradiation (Rad-Sure)
 - b. Blood group antigens
 - i. The fellow will be able to compare and contrast clinically significant and insignificant antigens with respect to transfusion limitations, as well as hemolytic disease of the fetus/newborn (HDFN)
 - ii. Human leukocyte antigens (HLA)
 - i. The fellow will be able to discuss testing methodologies and algorithms for suspected cases of immune mediated platelet refractoriness
 - c. Antibodies
 - i. The fellow will be able to recognize the testing necessary for diagnosis and management for cases of
 - i. Warm autoimmune mediated hemolytic disease
 - ii. Cold autoimmune mediated hemolytic disease
 - The fellow will be able to discuss the importance of thermal amplitude and titer, as well as make recommendations for/against the use of a blood warmer
 - iii. Drug-induced hemolytic anemia
 - The fellow will be able to recognize the most commonly implicated drugs resulting in immune mediated hemolysis
 - iv. Hemolytic disease of the fetus/newborn
 - The fellow will be able to discuss the currently known limitations for titers on known clinically significant alloantibodies
 - d. The fellow will be able to manage unique transfusion needs for:
 - i. Sickle cell disease patients
 - ii. Emergency release of blood (trauma blood)
 - iii. Massive transfusion protocol

- Blood Products
 - a. The fellow will serve as a blood bank liaison for the appropriate and evidence-based use of blood products available at VUMC
- The fellow will be able to compare and contrast transfusion complications
 - a. FNHTR
 - i. The fellow will understand the use of leukocyte filters, comparing and contrasting the pre-storage leukoreduction to bedside leukoreduction
 - b. Acute hemolytic transfusion reactions
 - i. The fellow will be able to understand the risks of transfusion, especially in the context of acute hemolytic transfusion reactions
 - i. The fellow should be able to determine likelihood of occurrence, management, and reporting
 - c. Delayed transfusion reactions
 - i. The fellow should be able to differentiate delayed serologic from delayed hemolytic transfusion reactions
 - d. Bacterial contamination
 - i. The fellow should be able to discuss limitations for current bacterial detection culture methodologies
 - ii. The fellow should be able to compare and contrast most commonly encountered microorganisms across all blood products
 - e. Allergic transfusion reactions
 - i. The fellow should be aware of the randomized controlled trials for premedication
 - f. TRALI/Cardiopulmonary overload
 - i. The fellow should be able to compare and contrast consensus guideline for TRALI
 - ii. The fellow should be able to compare and contrast chest x-ray finding for both entities

INTERPERSONAL AND COMMUNICATION SKILLS

- The fellow will actively participate in pathology resident and medical technologist education
- The fellow will serve as the resource for resident education, including call related issues
- The fellow will participate in continuing education lectures for medical technologists
- The fellow will effectively communicate complex clinical information to other members of the health care team as well as, where appropriate, to patients and family members.

PROFESSIONALISM

- The fellow should be able to work effectively with medical technologists, residents, attendings, and patients
- The fellow should be able to implement management-related decisions by participating in transfusion committee and patient blood management committee
- The fellow will strive at all times during work hours to be punctual for meetings as well as timely and accurate with regard to administrative, patient and education assignments

SYSTEMS-BASED PRACTICE

- By the end of the fellowship the fellow should be able to:
 - a. Effectively manage shortages of blood products ranging from increased demand to decreased supply across a broad range of clinical settings

- b. Work with microbiology staff on suspected transfusion reactions as well as look back investigations from potentially infectious units
- c. Work with the clinical chemistry/coagulation staff to:
 - i. Assess IgA status of patients, with a focus on determination of IgA deficient patients who've demonstrated anti-IgA antibodies
 - ii. Utility of platelet transfusions in ITP, TTP, or acute intracranial bleeding
 - iii. Utilization of blood products in surgery
 - The fellow should be familiar with common coagulation related tests including PFA and TEG
- d. Work with the pediatric and hematology/oncology staff to ensure proper weight-based dosing of blood products and irradiated blood products
 - i. The fellow should be aware of evidence-based transfusion thresholds for red blood cells and platelets in pancytopenic patients
 - ii. The fellow should participate in the evaluation for platelet refractoriness
- e. Work with ICU/ED staff to ensure proper utilization of MTP
- f. Work with the anesthesiology staff to ensure proper blood utilization intra-operatively

PRACTICE-BASED LEARNING

- By the end of the fellowship the fellow should understand
 - a. The common pitfalls in transfusion medicine
 - i. Non-evidence-based transfusion guidelines
 - ii. Inappropriate blood orders
 - b. Reporting mechanisms to FDA and VUMC QA/QC
 - c. Understand the CAP requirements for QA/QC testing
 - d. Actively participate in blood bank/transfusion medicine QA meetings
 - e. Attend quarterly meetings of the VUMC Transfusion Committee
 - f. Attend monthly VUMC Patient Blood Management Committee
 - g. Participation and evaluation of implementing new testing methodologies
 - h. Assist in feasible academic projects related to patient care that might involve collation of data for clinical/case reports.

COAGULATION AND HEMOSTASIS ROTATION - OBJECTIVES

The Coagulation Rotation for the transfusion medicine fellow will be oriented towards providing a substantially higher level of training in coagulation and hemostasis than is offered on the resident rotation. The activities of the fellow will encompass the following 3 areas with the following goals of activity in which residents do not have any participation:

- (1) To examine all cases in the Vanderbilt University Hospitals of failed anti-coagulation in the setting of bleeding and thrombosis;
- (2) To examine on a daily basis all patients scheduled for surgery on the operating room lists to see whether their PT, PTT, fibrinogen levels and platelet counts are adequate for surgical intervention and, if not, to alert the participating surgeon and determine the underlying potential causes of these lab values, and possibly to suggest perioperative interventions;
- (3) To be on call with a separate pager during work hours for the consults on complex cases in the hospital of bleeding and thrombosis that might require anti-coagulation interventions.

By attending the daily Monday through Friday sign-out rounds supervised by the attending physician, fellows also deepen their understanding of pathogenesis, diagnosis and management of bleeding and thrombotic disorders. The fellow will assist in teaching and guidance of the resident in presenting the

cases at rounds each day in addition to presenting the more complex cases of management of bleeding and thrombosis delineated in 1-3 above. The fellow will also present short didactic talks at these Rounds wherever appropriate to illustrate teaching points from the complex management cases each day. The following goals and objectives refer specifically to the coagulation laboratory.

THE FELLOW WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- To develop a more nuanced understanding of the use of coagulation parameters as guides to direct transfusion therapy and in particular to be able to manage complex cases at the intersection of coagulation and transfusion medicine
- To evaluate and be involved with physicians on other services in the management of patients with congenital bleeding disorders such hemophilia and von Willebrand disease
- To make accurate diagnostic identifications and to understand the complexities of treating of antibody inhibitors of coagulation, including the factor replacement therapy
- To acquire a more complex understanding of coagulation testing in monitoring therapy with an expanded variety of anticoagulants and antiplatelet agents
- To understand the evaluation of acute consumptive coagulopathies in critically ill patients, and chronic consumptive coagulopathies in patients with cancer or vascular disorders
- To be familiar with the complexities of testing and clinical monitoring of hypercoagulable states and thrombotic disorders
- To understand the indications for, and interpretation of, not only platelet aggregation studies but also more recent platelet function assays such platelet function analyzers and the interpretation of platelet function in thromboelastography (TEG)
- To understand the interpretation and management of thrombocytopenia in a variety of coagulopathic disease settings

MEDICAL KNOWLEDGE

- To develop a more complex and nuanced understanding of the physiology and pathophysiology of the plasma and platelet components of hemostasis, and how these components interact with blood vessels
- To assist the resident on service in generating a differential diagnosis for the cause of a bleeding disorder, based on clinical history and coagulation laboratory screening tests
- To be familiar with the current literature on our understanding of the processes that regulate normal coagulation, the pathophysiology of vascular thrombosis, and genetic factors that predispose to thrombosis
- To be familiar with the common causes of consumptive coagulopathies, as well as the management of more complex cases involving thrombosis such as thrombotic thrombocytopenia, and their diagnosis
- To understand the principles on which plasma coagulation analyzers and platelet aggregometers and newer technologies such thromboelastography (TEG) and platelet function analyzers
- To develop a more nuanced understanding of the effects of blood products and medications on coagulation tests

INTERPERSONAL AND COMMUNICATION SKILLS

- To serve as an additional liaison between the coagulation laboratory staff and clinician particularly in cases of complex management
- To serve as a “back-up call” consultant to the resident on service (with additional attending physician backup) for clinicians who need immediate analysis of a bleeding or thrombotic disorder. To provide assistance and advise the pathology resident on service in providing guidance on testing requests and interpretation to medical technologists in the coagulation laboratory
- To serve as the primary communicant between the coagulation service and physicians on other services dealing with cases involving coagulation and hemostasis
- To communicate effectively with laboratory staff to facilitate proper patient evaluation

PROFESSIONALISM

- To provide professional teaching and training guidance to the pathology resident on service
- To interact in a professional, helpful, and respectful manner with clinicians, other house staff, and technical and administrative staff
- To assist the pathology resident on service in preparing written reports in an accurate and timely fashion
- The fellow will strive at all times during work hours to be punctual for meetings as well as timely and accurate with regard to administrative, patient and education assignments

SYSTEMS-BASED PRACTICE

- To understand principles of QA (quality assurance) and QC (quality control) in the coagulation laboratory and to assist the laboratory technology and faculty in improving the service provided
- To participate in interpretation of results for CAP (College of American Pathologists) proficiency testing and to assist the laboratory from a clinical perspective in preparing for CAP visits
- To learn safety issues and regulations relevant to the coagulation laboratory and to understand the impact and need for such regulations in the broader clinical setting of the hospital
- To gain a deeper understanding of CAP and CLIA guidelines and requirements for the coagulation laboratory
- To gain a deeper understanding of LIS (laboratory information systems) issues relevant to the coagulation laboratory
- To understand the complexities of coagulation tests and how normal ranges are established in the coagulation laboratory
- To be able to make appropriate decisions about cost-effective testing

PRACTICE-BASED LEARNING

- To assist the pathology resident on service in providing interpretative reports of coagulation assay results based on the patient history and recent clinical course
- To examine all cases of failed anti-coagulation in the setting of bleeding and thrombosis at VUMC with the purpose of providing informed advice, in consultation with the pathology attending on service, to physicians on other services
- To survey all daily cases scheduled for surgery in order to ascertain whether their PT, PTT, fibrinogen and platelet levels are adequate for surgery, and to notify and advise surgeons and anesthesiologists of cases that might require re-evaluation or intervention prior to surgery

- To locate, appraise, and assimilate pertinent evidence of the most current and best-substantiated studies in the peer-reviewed literature on coagulation, particularly where these studies intersect with studies in transfusion medicine
- To serve as primary communicant between the coagulation service and other physicians in complex cases that may require anti-coagulation interventions
- To demonstrate effective problem-solving skills in diagnosis of blood-related disease
- To maintain a portfolio of all presentations, inspections, research and other projects done by the fellow that will be given to the program director and used in the fellow's evaluation

APHERESIS ROTATION AND STEM CELL COLLECTION/PHOTOPHERESIS UNIT - OBJECTIVES

Fellow will be familiar with all aspects of apheresis – plasmapheresis, leukapheresis and cytappheresis, as well as stem cell collection and photopheresis. The fellow will actively participate in all the physician activities of the unit while working closely with the attending physicians and residents and fellows on their service. The fellow will, where feasible, sign orders for apheresis procedures, take patient consents, and supervise all procedures being performed in the unit during the day. The fellow will also write notes on the patients and perform appropriate follow-up of patients on the wards

While on rotation in the apheresis unit in the Division of Nephrology and Hypertension, the fellows will gain further experience in the applications of apheresis in the management of specific diseases as delineated in the ASFA categories I-IV, in particular the accepted category I applications such as thrombotic thrombocytopenic purpura (TTP), sickle cell disease, Goodpasture's syndrome, myasthenia gravis, cryoglobulinemia, leukostasis and paraproteinemic polyneuropathies

THE FELLOW WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- Fellows will be able to discuss the risks and benefits of the peripheral stem cell collection. These encounters should include discussion on line placement, mobilization agent, side effects of mobilization agent, explanation of collection device (COBE Spectra), anticoagulant selection, run time, CD34 enumeration, and adverse events of the collection
- Line selection-understand the use of peripheral venous access, when it is indicated and when it cannot be achieved
- If venous access cannot be achieved, the fellow must understand the risks/benefits of a central line placement
 - a. Selection of appropriate apheresis line to withstand high flow rates
 - b. Risk of leaving line in for possible day#2 collection
- Mobilization agent
 - a. Understand the use of G-CSF (Filgrastim) versus GM-CSF versus AMD31000
 - b. Understand location of subcutaneous administration
 - c. Understand the cost of medications
 - d. Understand the timing of administration of medication relative to collection
- Side effects of medication
 - a. Understand the known complications of the above listed agents
 - i. Understand the interventions used to mitigate the side effects
 - ii. Use of mobilization agents in special situations

- In donors over age 75
 - In donors with known history of severe coronary artery disease (CAD)
- Collection Device
 - a. The fellow should be familiar with manufacturer manual for collection device
 - iii. Troubleshooting of device
 - iv. Alarms within device
 - Anticoagulant selection
 - b. The fellow should understand the risk/benefits of citrate versus alternative anticoagulation
 - Treatment of citrate toxicity
 - i. Ionized calcium level understanding
 - Run time on collection device
 - i. The fellow should understand and be able to calculate the donors total blood volume and understand the number of liters processed (number of blood volumes processed)
 - ii. The fellow should understand the clinical goals of collection
 - Autologous
 - Allogeneic
 - CD34 enumeration
 - iii. The fellow should be familiar with the flow cytometry enumeration of CD34 cells
- Adverse events of collection
 - a. Access issues
 - i. Line (please see above)
 - ii. Line clot
 - The fellow should understand the need for tPA administration in port if central line is present
 - b. Anticoagulant toxicity
 - i. Citrate
 - The fellow should understand the use of PO medication and IV administration of calcium
 - c. Air bubble identification
 - i. The fellow should understand this medical emergency and know the correct position to place the patient in following suspicion of air bubble in line in machine.

MEDICAL KNOWLEDGE

- The fellow should be able to understand the use of peripheral blood stem cell collection as it pertains to transplantation
 - a. The fellow should understand the pros and cons of peripheral stem cell utilization versus cord blood versus marrow harvest
- The fellow should be able to compare and contrast mobilization agents, including dose, route, day of collection, and side effect profile.
- The fellow should be able to compare and contrast continuous versus discontinuous collection devices, including calculations regarding total blood volume, plasma volume, and safe extracorporeal blood volume

- The fellow should be able to troubleshoot collection issues by quickly and effectively consulting collection device manufacturer if there is a machine failure
 - The fellow should be able to conduct a complete physical exam prior to peripheral blood stem cell collection
 - a. Exam should focus on known side effect profile of mobilization agent, line assessment, and overall donor status

INTERPERSONAL AND COMMUNICATION SKILLS

- The fellow should understand the roles of the apheresis nurse, pathology resident, transplant nurse practitioner (NP)
 - a. The fellow should be able to review standing order medications to ensure appropriate patient care needs are met
- The fellow should understand the basis of donor health screening questions
 - a. If positive screening question is identified fellow must know who to contact-transplantation team
 - b. The fellow should be able to compare and contrast the donor health questionnaire used for peripheral stem cell collection versus whole blood/platelet collection.
 - i. The fellow should be able to discuss differential storing technologies in light of potential infectious disease agents within peripheral stem cell collection (i.e. in liquid nitrogen versus liquid nitrogen vapor)
- The fellow should be able to quickly and effectively communicate peripheral stem cell count enumeration to the clinical transplant team
 - a. The fellow should be able to assess collection effectiveness given the targeted collection total
 - b. The fellow should be able to assess donor weight and contrast with recipient weight for possible collection prolongation
- Peripheral stem cell collection requires professional communication with medical personnel at all levels as well as the donor and any accompanying individuals that the donors brings to clinic (medical technologist in flow cytometry, nurses in clinic, resident, and attending)-these discussions should always be carried out with dignity and respect
- The fellow should be able to effectively utilize hospital translation service in the event the patient/donor is non-English speaking
- The fellow will effectively communicate with other caregivers as well as, where appropriate, with patients and family members
- The fellow will strive at all times during work hours to be punctual for meetings as well as timely and accurate with regard to administrative, patient and education assignments

PROFESSIONALISM

- The fellow will interact in a professional, helpful, and respectful manner with clinicians, other house staff and technical and administrative staff

SYSTEMS-BASED PRACTICE

- The fellow must be aware of the interaction between laboratory medicine, apheresis clinic, and transplant team
- The fellow should be able to contact hospital transport for patients unable to ambulate following collection
- The fellow should be able to determine the likelihood of a single day collection for healthy allogeneic donors versus autologous donors (both pre and post chemotherapy)
- The fellow should be able to compare and contrast the total number of days of mobilization agent as well as collection days for donors who have previously undergone chemotherapy

PRACTICE-BASED LEARNING

- The fellow should be able to maintain a spreadsheet of both autologous collection variables and allogeneic collection variable in an effort to determine institutional averages for CD34 enumeration on day of collection
- The fellow should be able to analyze data regarding mobilization characteristics
- The fellow should assist wherever feasible in academic projects related to patient care that might involve collation of data for clinical/case reports
- The fellow should maintain a portfolio of all presentations, inspections, research and other projects done by the fellow that will be given to the program director and used in the fellow's evaluation

BLOOD ASSURANCE OBJECTIVES

During this rotation the fellow will become familiar with all aspect of the process of blood donation including the information necessary for registration of donors, familiarity with the importance of medical history and physical examination for determination of donor acceptability, the procedure of phlebotomy of a donor, the various types of donor reactions and steps to follow to aid the donor, the testing requirements for donor processing, the process of preoperative autologous donation procedures including testing and labeling requirements

THE FELLOW WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- The fellow should be able to evaluate potential donors, both whole blood and apheresis platelet donors for suitability
- The fellow should be able to understand the volunteer blood donor program including the following areas:
 - a. Recruitment
 - i. Compare and contrast allogeneic versus autologous donations, including limitations of both
 - b. Scheduling
 - i. The fellow should be aware of blood donation intervals
 - ii. The fellow should compare and contrast the blood donation intervals for whole blood donation, double red blood cell donation, and apheresis platelet donation
 - c. Inventory Management

- i. The fellow should be aware of blood group typing and how it relates to targeted approaches to recruiting of healthy volunteers
- d. Database management
 - i. The fellow should be aware of database management for donors
 - ii. Including interval donations and infectious disease results
- e. Marketing
 - i. The fellow should be aware of various marketing strategies for recruitment purposes
 - Compare and contrast non-reimbursed donors versus historic control of reimbursed donors for infectious disease results
- f. Public Relations
 - i. The fellow should be aware of the business model and how it relates to effective utilization of biologic products
- g. Donor Recognition
 - i. The fellow should be aware of practices for donor retention, including donor recognition

MEDICAL KNOWLEDGE

- The fellow should be aware of the universal donor health questionnaire (DHQ), and what questions are asked
 - a. Compare the FDA mandated questions to current ARC practices
 - i. The fellow should be able to incorporate current trends in donation
 - literature contrasting US practices versus non-US practices
 - Infectious disease
 - MSM
 - Tattoo
- The fellow should be aware of the initial immunohematologic screening and follow-up of donors
 - a. The fellow should be aware of the medical management of positive direct antiglobulin tests (DAT) in healthy donors
 - i. Compare and contrast the current medical literature for debates regarding possible future cancer risk in DAT positive donors
- The fellow should be aware of the complex algorithm used to make blood components
 - a. FFP
 - b. FP24
 - c. Whole blood derived platelets
 - d. Cryo
 - e. Red blood cells
 - f. Granulocytes

INTERPERSONAL AND COMMUNICATION SKILLS

- The fellow must be aware of the donor rights and privileges as it pertains to donation
 - a. Compare and contrast the rights of autologous donors with known positive infectious disease markers versus allogeneic donors
- The fellow must be aware of the complex communication used between the donor and the collection staff

- The fellow will utilize appropriate translation services where necessary in the case of communicating with non-English speaking patients
- The fellow should be aware of the critical need for documentation of donor health status as it pertains to post donation information (PDI)
 - a. The fellow should follow up on PDI case at VUMC to see impact of PDI

PROFESSIONALISM

- The fellow should be aware that the outside blood donation rotation is a professional place of business and requires the highest level of attention to detail
- The fellow will strive at all times during work hours to be punctual for meetings as well as timely and accurate with regard to administrative, patient and education assignments

SYSTEMS-BASED PRACTICE

- The fellow should be aware of the stakeholders who utilize the blood products collected
- The fellow should assist in feasible academic projects related to patient care that might involve collation of data for clinical/case reports
- The fellow should be aware of the work flow, including limitations to the donor collection process
- The fellow should look to identify areas in the work flow that result in both efficient and optimal utilization of nurses, phlebotomists, and donors' time
- The fellow should understand changes in procedures caused by shortages resulting from decreased donations or increased demand
- The fellow should understand the role of the donor center as part of a regional or national network requesting and supplying blood products as necessary

PRACTICE-BASED LEARNING

- The fellow should be aware of policies and practices regarding:
 - a. American Rare Donor Program
 - b. IgA and anti-IgA testing
 - c. Antigen-matched/antigen-negative units used for sickle cell disease patients

HEME/ONC /HEMEPATH ROTATION OBJECTIVES

FELLOWS ARE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- To develop enhanced proficiency in making accurate and cost-effective diagnoses of reactive and neoplastic diseases of the lymph nodes and hematopoietic system
- To be familiar with the WHO classification schemes for lymphoma and bone marrow cases, and apply currently used schemes to individual cases in an appropriate fashion
- To correlate at a more advanced level clinical findings with morphology of lymph nodes and bone marrow
- To learn at a more advanced level than in residency, the appropriate selection of diagnostic tests, including flow cytometry and immunohistochemistry
- To correlate clinical findings with morphology of lymph node, bone marrow and peripheral blood smears

MEDICAL KNOWLEDGE

- To continue to develop knowledge of the clinical, pathogenetic, morphologic, immunophenotypic, and genetic features of the more common diseases of the hematopoietic and lymphoid systems
- To understand blood product selection and appropriate transfusion support for hematologic malignancies
- To understand the significance of various diagnoses of diseases involving the lymphoid system, in determining treatment plans
- To become familiar with outcomes and prognoses of common diseases of the lymph nodes and common hematologic diseases

INTERPERSONAL AND COMMUNICATION SKILL

- To serve as a consult liaison between the transfusion service and the heme-onc service
- To communicate clearly with clinical colleagues to obtain clinical information in case evaluation
- To communicate diagnoses and describe the features that support those diagnoses effectively, both verbally and in written reports
- To present cases at interdivisional and intra-divisional conferences to support continuing medical education of staff, residents, and fellows

PROFESSIONALISM

- To recognize and be sensitive to the needs of patients and clinicians in making timely diagnoses in a cost-effective manner appropriate to the clinical circumstances of each case
- To work effectively and efficiently with support and administrative staff in the hematology lab, flow cytometry, and hematopathology to maximize productivity and maintain the quality of the work environment
- To complete written reports in a timely fashion
- To communicate complex and unusual diagnosis to referring pathologists and other physicians in consultative cases

SYSTEMS-BASED PRACTICE

- To learn the process of case evaluation and workflow in the hematopathology lab, from accessioning and
- processing of lymph node biopsies and consult cases, to sign-out and delivery of patient reports.
- To use awareness of laboratory workflow to optimize efficiency and turn-around time through working with

- laboratory, administrative, and secretarial staff
- To develop skills in selecting the most cost-effective diagnostic studies that provide quality medical care
- To develop awareness of issues in coding, and skills in coding to ensure that cases are billed appropriately to level of effort

PRACTICE-BASED LEARNING

- To use case-based learning as a tool for additional insight into the basis of disease
- To locate, appraise, and assimilate pertinent evidence from scientific studies
- To demonstrate effective problem-solving skills in diagnostic lymph node pathology, using a wide variety of information resources

CELLULAR THERAPY ELECTIVE

The Cellular Therapy Elective is designed to build upon foundational knowledge in transfusion medicine and provide advanced training in the clinical, laboratory, and regulatory aspects of cellular therapy. The learner will develop the skills necessary to function as an effective consultant and laboratory director in a cellular therapy laboratory (CTL), with an emphasis on patient safety, quality management, and regulatory compliance.

THE LEARNER WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- The learner will participate in the evaluation and management of patients and donors involved in cellular therapy processes.
- The learner will:
 1. Review indications for hematopoietic progenitor cell (HPC) transplantation and correlate with clinical scenarios.
 2. Perform donor eligibility assessments for related donors in accordance with regulatory standards.
 3. Evaluate cellular therapy products and interpret processing results for clinical suitability.
 4. Assess post-infusion adverse events and recommend appropriate diagnostic and management strategies.
 5. Identify deviations from standard operating procedures (SOPs) and determine their potential impact on patient care.

MEDICAL KNOWLEDGE

- The learner will demonstrate a comprehensive understanding of cellular therapy principles, including:
 1. Indications, advantages, and limitations of autologous and allogeneic transplantation.
 2. Methods of cellular therapy collection, processing, cryopreservation, and storage.
 3. Processing techniques for HPC products, including plasma and red cell reduction.
 4. Specialized cellular therapy procedures, including immune effector cell therapies and pancreatic islet cell isolation.

5. Current literature and evidence-based practices related to cellular therapy.
- The learner will apply evidence-based medicine principles to clinical and laboratory decision-making.

INTERPERSONAL AND COMMUNICATION SKILLS

- The learner will:
 1. Effectively communicate consultative recommendations to clinical teams, including physicians, nurses, laboratory staff, and other stakeholders.
 2. Clearly convey complex information regarding cellular therapy processes, complications, and quality issues.
 3. Participate in interdisciplinary discussions, including transplant and quality committee meetings.
 4. Develop and demonstrate effective presentation skills in formal and informal educational settings.

PROFESSIONALISM

- The learner will:
 1. Demonstrate accountability, reliability, and ethical behavior in all clinical and laboratory activities.
 2. Interact respectfully and collaboratively with patients, donors, and members of the healthcare team.
 3. Maintain confidentiality and adhere to institutional and regulatory standards.
 4. Show initiative in participating in CTL operations and continuous improvement activities.

SYSTEMS-BASED PRACTICE

- The learner will develop an understanding of the cellular therapy laboratory within the broader healthcare system and will:
 1. Describe the role of the medical director in CTL oversight, including regulatory compliance and operational management.
 2. Participate in quality management activities, including audits, event investigations, and process improvement.
 3. Apply regulatory and accreditation standards (e.g., FACT, CAP, FDA) in laboratory practice.
 4. Perform mock inspections and evaluate laboratory readiness for accreditation.
 5. Collaborate with multidisciplinary teams, including transplant programs and transfusion committees.
 6. Understand resource utilization and laboratory operations, including personnel, workflow, and financial considerations.

PRACTICE-BASED LEARNING

- The learner will engage in continuous improvement and scholarly activity by:
 1. Evaluating proficiency testing results and implementing corrective actions where appropriate.
 2. Identifying errors, near-misses, and system deficiencies, and contributing to improvement strategies.
 3. Designing, reviewing, and interpreting validation studies.
 4. Developing, revising, and implementing standard operating procedures.
 5. Applying evidence-based literature to improve laboratory and clinical practice.
 6. Participating in quality assurance and quality improvement initiatives.

LABORATORY MANAGEMENT AND QUALITY SYSTEMS

- The learner will:
 1. Describe the components of a comprehensive quality management program in a CTL.
 2. Analyze quality metrics and their impact on laboratory performance and patient outcomes.
 3. Investigate adverse events, including root cause analysis and corrective/preventive actions (CAPA).
 4. Participate in change control processes and validation of new assays or procedures.
 5. Demonstrate familiarity with document control, SOP development, and regulatory documentation requirements.

HLA ELECTIVE

The Histocompatibility and Immunogenetics (HLA) Elective is designed to provide advanced training in the principles and practice of transplantation immunology, histocompatibility testing, and laboratory management. The learner will develop expertise in HLA typing, antibody testing, crossmatching, and clinical interpretation of histocompatibility results, while gaining familiarity with quality systems, regulatory requirements, and multidisciplinary transplant care.

THE LEARNER WILL BE EXPECTED TO GAIN THE FOLLOWING COMPETENCIES:

PATIENT CARE

- The learner will participate in the evaluation of transplant candidates and donors through the interpretation of histocompatibility testing results.
- The learner will:
 1. Assess HLA compatibility in patients undergoing renal, heart, lung, and hematopoietic stem cell transplantation (HSCT).
 2. Correlate HLA typing, antibody testing, and crossmatch results with clinical transplant outcomes and immunologic risk.

3. Evaluate donor-specific antibodies (DSAs) and recommend appropriate testing or monitoring strategies.
4. Review post-transplant histocompatibility results and assess their significance for graft monitoring.
5. Apply HLA matching principles to the selection of compatible platelet products in alloimmunized patients with platelet refractoriness.
6. Participate in multidisciplinary discussions involving transplant candidacy, donor selection, and immunologic risk assessment.

MEDICAL KNOWLEDGE

- The learner will develop a comprehensive understanding of transplantation immunology and histocompatibility testing, including:
 1. HLA genetics, inheritance patterns, nomenclature, and antigen expression.
 2. HLA-A, -B, -C, -DRB1, -DQB1, and -DPB1 typing methodologies.
 3. Molecular testing platforms, including next-generation sequencing (NGS) and sequence-specific oligonucleotide (SSO) technologies.
 4. The immunologic basis of allograft rejection and alloimmunization.
 5. Antibody screening and identification techniques, including Luminex-based single antigen bead assays.
 6. Interpretation of donor-specific antibodies and assessment of their clinical significance.
 7. Principles, advantages, and limitations of complement-dependent cytotoxicity (CDC) and flow cytometric crossmatching.
 8. Applications of histocompatibility testing in both solid organ transplantation and hematopoietic stem cell transplantation.
 9. Chimerism testing methodologies and their role in monitoring engraftment, graft failure, and disease relapse following HSCT.

INTERPERSONAL AND COMMUNICATION SKILLS

- The learner will:
 1. Effectively communicate histocompatibility testing results and consultative recommendations to clinicians and transplant teams.
 2. Participate in multidisciplinary transplant selection and patient management discussions.
 3. Communicate complex laboratory findings, including antibody profiles and crossmatch results, in a clear and clinically meaningful manner.
 4. Develop effective presentation skills through participation in educational conferences, laboratory discussions, and case reviews.

5. Collaborate with physicians, nurses, transplant coordinators, laboratory personnel, and other healthcare professionals involved in transplant patient care.

PROFESSIONALISM

- The learner will:
 1. Demonstrate accountability, integrity, and ethical conduct in all laboratory and clinical activities.
 2. Maintain confidentiality of patient, donor, and laboratory information.
 3. Demonstrate responsibility and follow-through in the completion of assigned clinical, educational, and laboratory tasks.
 4. Interact respectfully with patients, transplant recipients, donor families, and members of the healthcare team.
 5. Recognize the critical impact of accurate histocompatibility testing on patient outcomes and transplant safety.

SYSTEMS-BASED PRACTICE

- The learner will understand the role of the histocompatibility laboratory within the transplant healthcare system and will:
 1. Participate in multidisciplinary transplant review activities, including donor-recipient compatibility assessments and virtual crossmatch evaluations.
 2. Understand laboratory workflows supporting solid organ and hematopoietic stem cell transplant programs.
 3. Describe the impact of histocompatibility testing on organ allocation, donor selection, and transplant outcomes.
 4. Recognize the importance of effective resource utilization in high-complexity HLA testing.
 5. Understand the integration of histocompatibility laboratory services with transplant centers, blood banks, cellular therapy laboratories, and clinical teams.
 6. Participate in problem-solving and process improvement activities related to transplant immunology services.

PRACTICE-BASED LEARNING AND IMPROVEMENT

- The learner will engage in continuous quality improvement and scholarly activity by:
 1. Applying current literature and evidence-based practices to histocompatibility testing and transplant immunology.
 2. Reviewing challenging clinical cases and evaluating laboratory data to improve diagnostic accuracy.
 3. Identifying testing limitations, discrepancies, and potential sources of laboratory error.
 4. Participating in quality assurance, quality control, and proficiency testing activities.

5. Contributing to laboratory improvement projects and process optimization initiatives.
6. Reviewing new technologies and emerging applications in transplantation immunology and molecular diagnostics.

LABORATORY MANAGEMENT, QUALITY, AND REGULATORY COMPLIANCE

- The learner will:
 1. Describe the responsibilities of the HLA laboratory medical director and laboratory leadership team.
 2. Understand the regulatory and accreditation requirements governing histocompatibility laboratories, including ASHI, CAP, CLIA, and applicable federal regulations.
 3. Participate in laboratory quality management activities, including proficiency testing review, incident investigations, and corrective and preventive action (CAPA) processes.
 4. Understand validation and verification requirements for new HLA assays and testing platforms.
 5. Review standard operating procedures and assess compliance with regulatory standards.
 6. Interpret quality metrics and evaluate their impact on laboratory performance and patient safety.
 7. Participate in internal audits, accreditation readiness activities, and continuous quality improvement initiatives.
 8. Develop an understanding of test utilization, laboratory informatics, and operational management within a high-complexity histocompatibility laboratory.

SKILLS AND COMPETENCIES THE FELLOW SHOULD MASTER BY THE END OF THE FELLOWSHIP

Patient Care

1. Able to make recommendations for appropriate usage of all blood products in specific clinical settings and in patients with specific illnesses and underlying conditions
2. Able to make appropriate pretransfusion evaluations including appropriate crossmatching methods and complex serologic analyses
3. Able to make appropriate recommendations for treatment of all major transfusion reactions occurring in transfused patients
4. Able to independently management blood products requirements and transfusion therapies in the clinical settings commonly encountered in transfusion medicine, with in-depth understanding of the following conditions:
 - Autoimmune hemolytic anemias
 - Platelet refractoriness
 - Thrombotic thrombocytopenia
 - Idiopathic thrombocytopenia
 - Hemoglobinopathies
 - Hematopoietic and solid organ transplantation
5. Demonstrates a working knowledge of blood product management in pediatric and perinatal transfusion clinical settings
6. Able to manage situations in which patients refuse blood
7. Can supervise and manage autologous and allogeneic (including National Marrow Donor Program unrelated donations) peripheral stem cell collections and clinically evaluate patients undergoing such procedures
8. Can manage and supervise the procedure of extracorporeal photopheresis (both continuous and discontinuous devices) and perform basic clinical evaluation of patients undergoing this procedure
9. Understands and can evaluate blood product usage for erythrocytapheresis, leukapheresis and therapeutic plasma exchange
10. Able to distinguish when apheresis versus manual exchange would be beneficial and make appropriate recommendations

11. Understands the ethical complexities and is able to supervise obtaining informed consent from patients for transfusion-related procedures such as apheresis and photopheresis and for the provision of blood products and derivatives
12. Able to conduct a blood donor interview and exam and appropriately apply screening criteria for exclusion of incompatible donors

Medical Knowledge

1. Demonstrates working knowledge of all assays and methodologies involved in pre-transfusion blood product testing including the various kinds of manual and automated assays used in the blood type and screen, direct and indirect antiglobulin testing, D antigen compatibility, as well as the different crossmatching tests
2. Can reliably and accurately analyze and understand complex serologic panels of clinically significant antigens as performed by the blood bank technologists
3. Understands the underlying biology and fundamental genetics of the major blood groups systems, the complexities of bench serologic antigen testing, as well as the emerging science of genotypic testing of these antigens
4. Can identify and differentiate clinically significant and insignificant allo- and auto-antibody panels and appropriately advise clinical teams on transfusion recommendations
5. Understands and can differentiate RhD serologic variants and their clinical implications in obstetrics/gynecology and other services
6. For clinically significant antibodies identified, understands and can clinically manage complex serologic evaluations, including use of Rare Donor Network
7. Understands the biology of histocompatibility, the fundamentals of histocompatibility testing (HLA), is able to interpret laboratory results of such laboratory testing and able to make appropriate recommendations to clinical teams regarding the results of such testing
8. Demonstrates knowledge of platelet antigen biology and appropriate testing in specific clinical scenarios
9. Demonstrates working knowledge of the apheresis methodologies and the basics of apheresis instrumentation
10. Demonstrates working knowledge for serologic testing of donor products
11. Understands the complexities of infectious disease screening of donor products including HIV screening, Hepatitis B and C screening, West Nile Virus screening as well as syphilis, HTLV and Chagas Testing of donor products
12. Understands the complexities of bacterial testing of donor products

13. Able to manage the reversal of anticoagulation, particularly warfarin, in settings requiring urgent transfusion
14. Able to manage the laboratory testing and transfusion requirements of the major congenital bleeding disorders including von Willebrand disease, factor deficiency disorders, hemophilias and disorders of fibrinogen
15. Understand and able to manage the laboratory testing and transfusion requirements of immune-mediated coagulopathies including hemolytic uremic syndrome, thrombotic thrombocytopenic purpura and antiphospholipid syndrome
16. Able to manage the laboratory testing and transfusion requirements of inherited and acquired immune platelet function disorders
17. Able to effectively manage the transfusion requirements of neonatal congenital, alloimmune and acquired thrombocytopenias
18. Understand the biological mechanism and able to manage the laboratory testing and transfusion requirements of the major acquired bleeding disorders in clinical situations such as pregnancy, liver disease, vitamin K deficiency, renal disease, cancer, cardiac disease and cancer

Interpersonal and Communication Skills

1. Can communicate coherently and professionally about all essential aspects of the blood supply line with both members of the blood bank staff as well as clinicians and other hospital staff
2. Is an effective teacher on all subjects in transfusion medicine to medical residents, students and technologists, and demonstrates an ongoing willingness and flexibility to learn from others
3. Is adept at organizing and communicating complex medical information in transfusion medicine
4. Can communicate effectively and compassionately with patients and their families
5. Able to serve and communicate effectively in the capacity as a transfusion consultant with other clinicians, nurses and hospital staff

Professionalism

1. Demonstrates respect and compassion in dealing with patients and their families and is respectful and collegial in dealing with hospital staff, faculty and colleagues
2. Demonstrates principles of confidentiality with medical information transmitted verbally and electronically both during and outside patient encounters

3. Demonstrates general commitment to excellence and personal professional development
4. Demonstrates commitment to working effectively within hospital team settings
5. Demonstrates positive work habits in terms of dependability, punctuality and professional appearance
6. Interacts with others without discriminating on basis of educational differences, sexual orientation, ethnic or religious differences
7. Adheres appropriately to regulatory issues pertaining to blood products usage and use of human subjects in research

System-Based Practice

1. Demonstrates a coherent and reliable perspective on how blood transfusion services operate and how the blood supply line is maintained from vein to vein
2. Demonstrates sound knowledge of the science and practice of blood component separation as well as product storage conditions according the most recent *AABB Standards*
3. Understands the appropriate clinical usage of all blood components and is independently able to make appropriate recommendations to clinical teams regarding their usage in basic and complex clinical situations
4. Understands the methodologies and appropriate applications of product modifications including irradiation, leukoreduction, freezing, washing and volume reduction for the purpose of advising clinicians on other services
5. Understands the correct procedures blood product labeling and release of blood products according to the most recent *AABB Standards*
6. Can independently make appropriate recommendations to clinical teams for effective utilization of all blood products and derivatives in complex clinical scenarios
7. Understands the ethical complexities and is able to supervise obtaining informed consent from patients for transfusion-related procedures such as apheresis and photopheresis and for the provision of blood products and derivatives
8. Able to implement appropriate blood conservation strategies to avoid blood wastage especially under situations of blood product shortage
9. Understands and can critically review activation of the adult and pediatric massive transfusion protocols

10. Can make appropriate recommendations for blood product utilization in surgical and perioperative situations particularly those with high blood product requirements such as cardiac surgery and liver transplantation
11. Understands the complexities of basic coagulation testing including the PT/INR, PTT, platelet assays and fibrinogen levels and is able to make appropriate follow up recommendations based on results of such testing

Practice-Based Learning and Improvement

1. Demonstrates capacity to review hospital transfusion policies and make recommendations for appropriate changes for improvements
2. Understands and can apply the criteria for safe blood donor selection
3. Can effectively participate in and intellectually contribute to meetings of the hospital Transfusion Committee as well as other hospital transfusion committees such as the Patient Blood Management Committee so as to effectively contribute to hospital-wide blood transfusion management
4. Understands and can participate in FDA/AABB/CAP inspections, including development of action item(s) for response to inspections
5. Participates in daily blood transfusion QA/QC development and management
6. Can evaluate a blood bank's compliance with accreditation standards and regulations and develop a strategy to ensure such compliance
7. Able to effectively review and write a Standard Operating Procedure (SOP) document
8. Understands basics of blood bank leadership and business management
9. Able to supervise the collection, processing and storage of human stem cells
10. Can advise on the recruiting, evaluation and selection of appropriate stem cell donors
11. Understands the screening procedures and quality control processes for tissue donations
12. The following texts will be available to the fellow for study during the program:

- **Transfusion Therapy, or 4th Edition**, Edited by Marisa Marques, Joseph Schwartz & Yanyun Wu. Association for the Advancement of Blood & Biotherapies(AABB); 2019.
- **Pediatric Transfusion: A Handbook, 6th Edition, Edited Edward Wong**. AABB; 2024.
- **Transfusion Reactions, 5th Edition, Edited** by Patricia Kopko. AABB; 2021.
- **Transfusion Medicine & Hemostasis: Clinical and Laboratory Aspects, 4th Edition, Edited** by Beth Shaz, Christopher Hillyer, Joseph Schwartz & Morayma Reyes Gil. AABB; 2024.
- **Modern Blood Banking and Transfusion Practices**, 7th Edition, Edited by Denise Harmening. F.A. Davis Company; 2018.
- **Technical Manual, 20th edition**, Edited by Claudia Cohn, Meghan Delaney, Susan Johnson & Louis Katz. AABB; 2020.