

Syllabus

**MD
TRANSFUSION MEDICINE
AIIMS
RISHIKESH**

All India Institute of Medical Sciences

Rishikesh – 249203

Transfusion Medicine — M D

1. Preamble

The goals of MD Transfusion Medicine course is to produce a specialist who is competent to provide Transfusion related services described below, and is able to teach undergraduates, and to a certain extent postgraduates, and should have an idea regarding research.

Transfusion medicine is a diverse and multifaceted discipline. It has overlaps with Clinical Pathology or Laboratory Medicine, Haematology, Immunology, Microbiology, Intravenous infusion therapy, Regulatory and cGMP aspects of biopharmaceuticals, Regenerative Medicine as well as unique arenas like donor mobilization and donor care. A hospital needs transfusion medicine experts not only for receiving and managing blood products, and its derivatives but also in scenarios as diverse as infection management, prenatal care, transplants, thromboprophylaxis, community outreach etc to name a few.

Some example skills and responsibilities of a transfusion medicine physician includes (a) Direct patient care eg therapeutic apheresis, therapeutic phlebotomy; (b) Clinical consultation eg coagulation, transfusion decisions in reaction, refractoriness or transfusion dependence, etc (c) Preparation of customized therapeutic products eg modified units of specified haematocrit, antigenicity; HLA matched irradiated platelets; autologous platelet rich plasma or fibrin; autologous stem cells, DLI, dendritic cells etc (d) Medical direction of clinical testing laboratories eg Immuno-hematology, coagulation, HLA, TTI testing, (e) Motivating and counselling skills of appealing and handling the general public not only do develop social awareness but to effectively collect sufficient donations to sustain the supply of blood products (f) Donor care and management of donor reaction (g) Supervision of blood component and special product manufacture, storage, modification and quality control, (h) inventory management and distribution, and (i) administrative and regulatory compliance at multiple levels to maintain ethical, medical and industrial quality and safety standards.

2. Aims

- 2.1** To impart comprehensive training in fundamental and applied aspects of Transfusion Medicine at postgraduate level leading to degree of MD in Transfusion Medicine.
- 2.2** To make the candidate competent to become consultants and teachers in Transfusion Medicine in various medical colleges and institutions for operating well organized & efficient transfusion services.
- 2.3** To impart training and stimulate interest in research in the field of Transfusion Medicine.

3. Objectives

3.1. Cognitive Domain

- 3.1.1.** To understand the basic principles and concepts presented in the transfusion medicine core curriculum and develop a fund of basic knowledge in the field.
- 3.1.2.** To appraise important advances, research and publications in the field of transfusion medicine
- 3.1.3.** To recognize problems in clinical medicine those are related to transfusion and apply concepts and principles in the core curriculum to clinical situations.
- 3.1.4.** To provide appropriate therapeutic solutions to transfusion medicine problems.
- 3.1.5.** To recognize motivational, organizational and managerial skills for efficient operation of blood center.

3.2. Psychomotor Domain

It is expected that at the end of the course, the blood transfusion specialist will be specifically equipped for the following tasks:

- 3.2.1. Able to carry out the investigative or therapeutic procedures of Transfusion Medicine
- 3.2.2. Should be able to interpret test results and effectively correlate clinical information
- 3.2.3. Provide medical direction to academic blood center with regard to organization of the collection, preparation, storage, distribution and optimal clinical utilization of blood, components and specialized products.
- 3.2.4. Should learn how to organize and present complex information to their colleagues.
- 3.2.5. Carry out research; maintain accurate records of research data or tests results systematically
- 3.2.6. Able to systematically write a paper and publish in a journal.
- 3.2.7. Able to present a paper in a conference through an oral presentation and poster presentation.
- 3.2.8. Should upgrade the scientific knowledge by continuing medical education
- 3.2.9. Should be able to identify problems in the laboratory and offer solutions thereof so that a high order of quality control is maintained.
- 3.2.10. Organize training program for manpower development in the field.

3.3. Affective Domain

- 3.3.1. Should show compassion and patience to patients and their families.
- 3.3.2. Should imbibe the elements of professionalism including reliability, diligence, sense of priority, a strong work ethic, efficient time management, and the aptitude to multitask.
- 3.3.3. Should develop or improve communication skills for carrying out their clinical responsibilities as first-line consultants for the transfusion service.
- 3.3.4. Should learn how to communicate efficiently, coherently, and understandably with colleagues, technicians, healthcare providers, patients and families, and to demonstrate a balanced personality.
- 3.3.5. Interactions should be courteous and respectful at all times, including when giving direction to those in subordinate positions.
- 3.3.6. Must feel the necessity of adherence to the principles of beneficence, nonmaleficence, justice, and respect for patient autonomy and privacy.

4. Course Content

Due to interdisciplinary nature of many of the areas of the subject any outline of the subject is unlikely to be precise. A postgraduate appearing for the MD degree is supposed to have acquired not only professional competence expected of a well-trained specialist but also academic maturity, a capacity to reason and critically analyse a set of scientific data. He is supposed to keep himself abreast with the latest developments in the field of transfusion medicine and related sciences. The competence expected at different skill levels are outlined below, followed by a brief outline of the syllabus.

Skill Level I = corresponds roughly to the types of activities and responsibilities that a first- and/or second-year MD student would be engaged in, that is, the level of achievement to be attained during the student's first exposure to the discipline as a postgraduate

Skill level II = corresponds to the achievements expected of a third year MD student that is, the higher level of responsibility and expertise that one would acquire and consolidate during repeat exposure to the discipline.

4.1 Competencies by topics:

4.1.1 Immunology and Immunogenetics

Skill Level I

- 4.1.1.1 Understand the basic principles of immunoglobulins, antigen, antibody and complements.
- 4.1.1.2 Understand complement activation pathways and their role in transfusion medicine
- 4.1.1.3 Understand the antibody development after immunization and infection
- 4.1.1.4 Understand the principles of antigen antibody reaction and factors affecting these reactions.
- 4.1.1.5 Understand the antigen systems of formed elements of blood such as red cells, platelets and leukocytes and be able to know their implications in transfusion medicine.
- 4.1.1.6 Understand the principles of structural and functional evaluation of B cells, T cells (including subsets e.g. Treg, TH17), NK cells etc.
- 4.1.1.7 Understand the principles of classification of primary immune deficiency diseases, including defects in humoral immunity, cellular immunity, innate immunity etc.
- 4.1.1.8 Understand the principles of basic genetics with regard to Mendelian law of inheritance, phenotype / genotype and population genetics.
- 4.1.1.9 Know the nomenclature, organization and polymorphism of the human major histocompatibility complex, including HLA class I, II, and III genes.

Skill Level II

- 4.1.1.10 Know the Hybridoma technology and be able to understand its role in Immunohematology.
- 4.1.1.11 Understand the role of HLA typing in organ and bone marrow/stem cell transplantation and how HLA antigen mismatching results in allogeneic reactions in recipients.
- 4.1.1.12 Know HLA typing techniques, including serological methods, microcytotoxicity assays, nucleic acid assays and lymphocyte culture techniques.
- 4.1.1.13 Understand the HLA association with disease
- 4.1.1.14 Molecular genotyping of blood groups.

4.1.2 Physiology of the formed elements of blood and hemostasis

4.1.3 Skill level I

- 4.1.3.1 Understand the basic physiology and biochemistry of red cells, platelets and leukocytes in terms of their kinetics, function and life span.
- 4.1.3.2 Understand hemoglobin structure, synthesis, function and degradation.
- 4.1.3.3 Know the membrane structure and function of red cells, platelets and leukocytes and be able to apply their implication in transfusion medicine
- 4.1.3.4 Understand the principles of hemoglobin screening
- 4.1.3.5 Describe iron and bilirubin metabolism
- 4.1.3.6 Understand the physiology of hemostasis with regard role of platelets, coagulation pathway and fibrinolysis
- 4.1.3.7 Understand the pathophysiology of thrombocytopenia and thrombocytosis
- 4.1.3.8 Know the pathophysiology and laboratory features of intravascular and extravascular hemolysis.

- 4.1.3.9 Develop basic understanding of hemostatic and thrombotic disorders:
- 4.1.3.10 Understand the coagulopathy of liver disease;
- 4.1.3.11 Understand the pathophysiology of vitamin K deficiency and antagonism;
- 4.1.3.12 Understand the laboratory evaluation of disseminated intravascular coagulation.
- 4.1.3.13 Understand the pathophysiology of the hemophilias (A, B, and C)

Skill level II

- 4.1.3.14 Understand hemodynamic of blood flow, estimation of blood volume and be able to interpret the application of radionuclides tagging for blood volume estimation
- 4.1.3.15 Understand the pathophysiology of immune thrombocytopenia and thrombotic thrombocytopenic purpura.
- 4.1.3.16 Demonstrate competency in taking a bleeding history.
- 4.1.3.17 Understand the general principles & clinical utility of platelet function testing.
- 4.1.3.18 Understand the clinical utility of coagulation and thrombosis testing.
- 4.1.3.19 Understand the general principles of screening coagulation tests (e.g., prothrombin time, activated partial thromboplastin time, fibrinogen, and thrombin time).
- 4.1.3.20 Understand the International Normalized Ratio derivation and its clinical significance.
- 4.1.3.21 Understand role of point of care testing in coagulation
- 4.1.3.22 Understand and interpret TEG/ROTEM/Sonoclot data
- 4.1.3.23 Understand work up of different types of Von Willebrand disease
- 4.1.3.24 Understand how to work up and monitor patients on different combinations of anticoagulation and platelet inhibition.

4.1.4 Blood Collection/Blood Center/Component Processing

Skill level I

- 4.1.4.1 Describe the factors that influence the motivation of volunteers to donate blood
- 4.1.4.2 Demonstrate professionalism in interactions with prospective donors.
- 4.1.4.3 Be able to know the clinical relevance of directed donation
- 4.1.4.4 Compare and contrast the eligibility requirements for allogeneic, autologous & apheresis blood donations.
- 4.1.4.5 Understand various types of autologous blood collection and their application in clinical transfusion service
- 4.1.4.6 Demonstrate proficiency in collection of whole blood with regard to preparation of phlebotomy site, proper volume and sample collection
- 4.1.4.7 Demonstrate proficiency in evaluating and treating adverse reactions associated with blood donation/phlebotomy (whole blood and apheresis donations).
- 4.1.4.8 Understand the factors influencing quality of blood bag for whole blood collection
- 4.1.4.9 Demonstrate the proficiency in organization of out door blood donation camp and be able to understand importance of cold chain maintenance.
- 4.1.4.10 Demonstrate knowledge of the indications for therapeutic phlebotomy.
- 4.1.4.11 Outline the assay principles of required donor blood tests such as donor Hb for whole blood donation and platelet count for plateletpheresis and the associated confirmatory testing and describe donor re-entry algorithms.
- 4.1.4.12 Understand the process of plateletpheresis
- 4.1.4.13 Summarize the steps in blood component preparation by different methods
- 4.1.4.14 Know various factors affecting the quality of blood components

- 4.1.4.15 Understand the significance of storage of blood components at appropriate temperature and demonstrate proficiency in compatibility, labeling requirements of various components

Skill Level II

- 4.1.4.16 Outline the necessary steps in donor notification and counseling associated with positive infectious disease testing results, and the donor look-back process.
- 4.1.4.17 Understand various modifications of blood components such as irradiation, cell washing, volume depletion and leuko depletion
- 4.1.4.18 Demonstrate proficiency in selection of apheresis machine, blood donor and be able to obtain apheresis product meeting quality standards
- 4.1.4.19 Demonstrate proficiency in maintaining quality of blood components as per recommended standards by various agencies (AABB, EC, DCI)
- 4.1.4.20 Understand process of plasma fractionation and summarize critical steps in preparation such as pooling, viral inactivation

4.1.5 Therapeutic Apheresis

Skill Level I

- 4.1.5.1 Summarize the principles of apheresis technology, including centrifugation, filtration, and immunoabsorption.
- 4.1.5.2 Demonstrate knowledge of the indications for therapeutic apheresis and of the appropriate replacement fluids to be used in various situations.
- 4.1.5.3 Demonstrate proficiency in evaluating and preparing patients for therapeutic apheresis, including discussion with the patient of the risks and benefits associated with apheresis procedures.
- 4.1.5.4 Communicate effectively with clinicians regarding emergent or scheduled therapeutic apheresis procedures through conversations and writing of consult notes

Skill Level II

- 4.1.5.5 Demonstrate proficiency in evaluating and treating adverse reactions associated with therapeutic apheresis.
- 4.1.5.6 Demonstrate proficiency in the treatment of patients using specialized methods (e.g., photopheresis and immunoabsorption columns).

4.1.6 Transfusion transmitted infection serology

Skill Level I

- 4.1.6.1 Understand the typical time course of appearance and disappearance of serum antigens and antibodies used in screening of major transfusion transmitted infection, including: HIV, hepatitis B, hepatitis C, cytomegalovirus, bacterial / fungal / protozoal infections and syphilis,
- 4.1.6.2 Understand and be able to interpret nontreponemal and treponemal antibody tests used to diagnose syphilis.
- 4.1.6.3 Compare & contrast various methodologies such as ELISA, rapid & chemiluminescence used in screening of transfusion transmitted infections
- 4.1.6.4 Demonstrate proficiency in proper disposal of bio hazardous material as per recommended standards

Skill level II

- 4.1.6.5 Understand the feasibility of NAT in Indian blood transfusion services
- 4.1.6.6 Demonstrate proficiency in the preparation and use of internal control in transfusion transmitted infection screening.

4.1.7 Clinical Transfusion Service

Skill Level I

- 4.1.7.1** Demonstrate knowledge of the principles of patient/ unit identification and pretransfusion testing, including ABO/Rh testing, RBC antibody screen, and antibody identification.
- 4.1.7.2** Compare and contrast conventional cross matching versus type and screen using various advanced technologies such as gel, solid phase, and column agglutination.
- 4.1.7.3** Recognize the symptoms and signs of hemolytic and nonhemolytic transfusion reactions and demonstrate knowledge of the pathophysiology, treatment, and prevention of these complications.
- 4.1.7.4** Identify the major noninfectious complications of blood transfusions, including red cell alloimmunization, transfusion-related acute lung injury, transfusion associated graft versus host disease, volume overload, post transfusion purpura, iron overload etc and the risk of these complications, and strategies to prevent them.
- 4.1.7.5** Choose appropriate blood components and derivatives based on a thorough knowledge of the indications for transfusion.
- 4.1.7.6** Demonstrate knowledge of the pathophysiology, prevention, and treatment of hemolytic disease of the newborn. Recognize those antibodies in pregnant patients that are clinically significant and make appropriate recommendations for blood products.
- 4.1.7.7** Demonstrate proficiency in preparation and transfusion of blood for intra uterine transfusion / exchange transfusion.
- 4.1.7.8** Demonstrate knowledge of the pathophysiology and treatment of neonatal alloimmune thrombocytopenia.
- 4.1.7.9** Demonstrate proficiency in the evaluation and appropriate transfusion therapy of thrombocytopenic patients (both adult and pediatric).
- 4.1.7.10** Apply the principles of a massive transfusion protocol.
- 4.1.7.11** Demonstrate a working knowledge of the principles of hemostasis and coagulation and proficiency in the initial treatment of patients with bleeding disorders.
- 4.1.7.12** Demonstrate knowledge of the transfusion requirements of special patient populations (e.g., hematology/ oncology, pediatrics, thalassemia, transplantation, cardiac surgery and burn/trauma).

Skill Level II

- 4.1.7.13** Identify clinically significant RBC antibodies from an antibody panel including multiple alloantibodies and mixtures of alloantibodies and autoantibodies; determine how difficult it will be to obtain blood for this patient, and effectively communicate these results to clinicians.
- 4.1.7.14** Demonstrate proficiency in evaluating and recommending treatment plans for complex transfusion reactions.
- 4.1.7.15** Demonstrate familiarity with the appropriate use of highly specialized blood products (e.g., granulocytes, donor lymphocyte infusions, HLA-matched platelets, and coagulation factor concentrates).
- 4.1.7.16** Demonstrate familiarity with the requirements of all applicable regulatory and accrediting agencies [e.g., DCI, NABH].
- 4.1.7.17** Demonstrate competence in the management of blood inventory and the ability to communicate effectively the hospital's needs to the blood supplier.
- 4.1.7.18** Demonstrate knowledge of various methods of blood conservation, including pre- and perioperative autologous blood collection, and approaches to "bloodless" surgery.
- 4.1.7.19** Demonstrate proficiency in evaluating patient's refractory to platelet transfusions. Outline the principles of histocompatibility testing and platelet cross-

matching and apply this knowledge in selecting appropriate platelet products when indicated. Demonstrate proficiency in the evaluation of patients with immune-mediated and non-immune-mediated hemolytic anemia and in the appropriate transfusion management of these patients.

- 4.1.7.20** Demonstrate knowledge of the principles of hematopoietic stem cell transplantation, including collection, processing, and storage of these stem cell products, and the indications for use (e.g., bone marrow, peripheral blood, and cord blood).
- 4.1.7.21** Develop an understanding of emerging areas of cellular therapy, including hematopoietic graft engineering and cellular immunotherapeutics.
- 4.1.7.22** Develop and understanding of blood substitutes and hematopoietic agents

4.1.8 Regulatory Skills / Quality Assurance/ Quality Control in blood transfusion Skill Level I

- 4.1.8.1** Demonstrate knowledge concerning the requirements of all applicable regulatory and accrediting agencies. [e.g., DCI, NABH, AABB]. Become familiar with the patient / blood donor privacy and data security requirements, including the use of institutional review board (IRB) protocols for conducting clinical research.
- 4.1.8.2** Understand training, certification, licensing, and competency assessment standards for transfusion laboratory professionals, including medical laboratory technicians.
- 4.1.8.3** Understand the importance of a comprehensive transfusion laboratory safety policy and program.
- 4.1.8.4** Understand how SOPs are used, developed, authored, and reviewed and their importance in mandatory laboratory inspection by various accrediting agencies.
- 4.1.8.5** Understand the role of quality assurance, quality management, and process improvement principles in laboratory operation and planning.
- 4.1.8.6** Be able to understand proper use of instrumentation and computerization in a transfusion laboratory

Skill Level II

- 4.1.8.7** Understand the role of risk management in the transfusion laboratory and become familiar with the nature of, patient safety initiatives, and forensic testing such as paternity testing.
- 4.1.8.8** Compare and contrast the various means of performing blood utilization reviews.
- 4.1.8.9** Explain the logistics required in determining appropriate blood inventory for a geographic region and the process of meeting daily, weekly and monthly collection goals.
- 4.1.8.10** Demonstrate understanding of the elements of current good manufacturing practices as they apply to the collection, processing, and storage of all blood components / products
- 4.1.8.11** Understand the principles & objectives of total quality management in transfusion service including premises, personnel, instruments / reagents, biosafety and external / internal quality control.
- 4.1.8.12** Know fundamental concepts of medical statistics.
- 4.1.8.13** Understand principles of specimen collection (e.g., phlebotomy technique, safety, and specimen tubes) and specimen processing.
- 4.1.8.14** Recognize sources of preanalytical variation and the role of biological variability in laboratory assessment.

4.1.9 ADDITIONAL COMPETENCIES SPECIFIC TO TRANSFUSION MEDICINE

4.1.9.1 Patient Care

- 4.1.9.1.1 Correctly classify transfusion reactions and give appropriate treatment recommendations.
- 4.1.9.1.2 Choose appropriate cross-matching methods for various patients (e.g., electronic, immediate spin, and antiglobulin).
- 4.1.9.1.3 Recognize and appropriately refer serological evaluations that are beyond the scope of a hospital-based transfusion service/blood bank.
- 4.1.9.1.4 Correctly choose (or recommend) the appropriate blood product for patients with special needs.
- 4.1.9.1.5 Triage and screen requests for blood components appropriately during inventory shortages.
- 4.1.9.1.6 Demonstrate the ability to perform blood utilization reviews.
- 4.1.9.1.7 Perform a donor interview and exam.
- 4.1.9.1.8 Evaluate and perform initial management of whole blood and apheresis donor reactions.
- 4.1.9.1.9 Write physician orders for peripheral blood hematopoietic stem cell collections and therapeutic apheresis procedures.
- 4.1.9.1.10 Appropriately manage reactions that occur during peripheral blood hematopoietic stem cell collections or therapeutic apheresis procedures.
- 4.1.9.1.11 Be able to apply recent developments in the field from research to clinical practice such as gene therapy, proteomics, microarray etc
- 4.1.9.2 Medical Knowledge**
- 4.1.9.2.1 Demonstrate understanding of and ability to interpret major regulations and guidelines that are applicable to collection, processing, storage, and release of blood and other cellular therapeutic products.
- 4.1.9.3 Practice-Based Learning and Improvement**
- 4.1.9.3.1 Demonstrate the ability to develop new policies and procedures or change existing policies and procedures based on a review of the literature or issuance of new guidelines by regulatory agencies.
- 4.1.9.4 Interpersonal and Communication Skills**
- 4.1.9.4.1 Demonstrate the ability to discuss the process of therapeutic apheresis with patients, and/or family members where appropriate; answer their questions; and obtain informed consent.

4.2 Subject Knowledge content overview

Subject	Course content
4.2.1 Blood donation	<ul style="list-style-type: none"> 4.2.1.1 Motivating factors for donation 4.2.1.2 Whole blood donation Vs apheresis donation 4.2.1.3 Types: allogeneic, autologous, directed 4.2.1.4 Donor questionnaire and interview: Eligibility and deferral criteria 4.2.1.5 Donor reactions and their management
4.2.2 Blood component preparation	<ul style="list-style-type: none"> 4.2.2.1 Basic steps in component preparation & labelling Composition & storage 4.2.2.2 Composition: volume, cellular, plasma and clotting factor content 4.2.2.3 Storage conditions for components 4.2.2.4 “Storage lesions”

- 4.2.2.5 Quality control standards
- 4.2.2.6 Specialized blood components – irradiated, volume reduced, pooled, leukoreduced, washed, reconstituted, frozen & deglycerolized, CMV free, HLA matched, HbS Negative
- 4.2.3 Plasma derivatives
 - 4.2.3.1 Basic principles of preparation & composition
 - 4.2.3.2 Recombinant clotting & hematopoietic growth factors
 - 4.2.3.3 Clinical indications and dosage
- 4.2.4 Blood groups
 - 4.2.4.1 Biochemical structure of major blood group antigens
 - 4.2.4.2 Clinically significant blood group antibodies
 - 4.2.4.3 Properties & significance of naturally occurring Vs unexpected antibodies
- 4.2.5 Pretransfusion testing
 - 4.2.5.1 Patient specimen labeling requirements
 - 4.2.5.2 Patient / component identification requirements
 - 4.2.5.3 ABO / Rh, Red cell antibody screen, Cross match
 - 4.2.5.4 Abbreviation of compatibility testing in emergency
- 4.2.6 Transfusion indications
 - 4.2.6.1 Red blood cells, Platelets, Plasma / cryoprecipitate, Granulocytes
- 4.2.7 Massive transfusion
 - 4.2.7.1 Metabolic complications
 - 4.2.7.2 Dilutional coagulopathy vs Trauma associated Coagulopathy
 - 4.2.7.3 Switching ABO / Rh types
- 4.2.8 Transfusion reactions and adverse events
 - 4.2.8.1 Diagnosis, Pathophysiology, Treatment, Prevention
- 4.2.9 Infectious complications
 - 4.2.9.1 Bacterial, parasitic, viral, prions
 - 4.2.9.2 Current risk & Prevention strategies
- 4.2.10 Transfusion therapy in special patients
 - 4.2.10.1 Hematology / Oncology
 - 4.2.10.2 Pediatric / neonatal
 - 4.2.10.3 Obstetric including intra uterine
 - 4.2.10.4 Cardiac surgery with CPB
 - 4.2.10.5 Burn patients & Trauma patients
 - 4.2.10.6 Transplantation: Stem cell / Bone marrow, Liver, Kidney, other
- 4.2.11 Hemolytic disease of new born
 - 4.2.11.1 Pathophysiology
 - 4.2.11.2 Causative blood group antibodies
 - 4.2.11.3 Monitoring, Treatment & Prophylaxis
- 4.2.12 Hemoglobinopathies
 - 4.2.12.1 Classification, Pathophysiology, Diagnosis & Transfusion therapy
- 4.2.13 Immune hemolytic anemia
 - 4.2.13.1 Warm, Cold, Drug induced hemolytic anemia

- 4.2.13.2 Comprehensive investigations for haemolytic anemia
- 4.2.13.3 Compatibility testing issues
- 4.2.13.4 Special transfusion needs
- 4.2.14 Thrombocytopenia
 - 4.2.14.1 Immune thrombocytopenic purpura
 - 4.2.14.2 Thrombotic microangiopathies (Including HUS-TTP and Disseminated Intravascular Coagulopathy)
 - 4.2.14.3 Post transfusion purpura
 - 4.2.14.4 Fetal and neonatal thrombocytopenia
 - 4.2.14.5 HIV, HCV & other infection associated thrombocytopenia
 - 4.2.14.6 Drug induced immune and nonimmune thrombocytopenias
 - 4.2.14.7 Heparin induced thrombocytopenia
 - 4.2.14.8 Aplastic, myeloablative and post transplant thrombocytopenias
- 4.2.15 Platelet refractoriness
 - 4.2.15.1 Recognition and evaluation
 - 4.2.15.2 Calculation of CCI and platelet recovery
 - 4.2.15.3 Principles of HLA typing and platelet cross match
 - 4.2.15.4 Selection of appropriate platelet product
- 4.2.16 Neutropenia
 - 4.2.16.1 Classification, etiology and treatment
 - 4.2.16.2 Granulocyte transfusion
- 4.2.17 Clotting factor disorders
 - 4.2.17.1 Principle of hemostasis & coagulation
 - 4.2.17.2 Lab tests of coagulation status
 - 4.2.17.3 Selection and dosage of factor preparations
 - 4.2.17.4 Management of patients with inhibitors
- 4.2.18 Transfusion alternatives
 - 4.2.18.1 Synthetic and natural volume expanders
 - 4.2.18.2 Hemoglobin solution, Perfluorochemicals, Fibrin glue, Hemostatic agent
- 4.2.19 Autologous blood
 - 4.2.19.1 Preoperative autologous deposit
 - 4.2.19.2 Perioperative blood salvage
 - 4.2.19.3 Acute normovolemic hemodilution
- 4.2.20 Laboratory management
 - 4.2.20.1 Quality assurance and quality control
 - 4.2.20.2 Automation in Transfusion Medicine
 - 4.2.20.3 Equipment procurement
 - 4.2.20.4 Writing policies and procedures
 - 4.2.20.5 Blood inventory management
 - 4.2.20.6 Look back
 - 4.2.20.7 Maximal surgical blood order schedule
 - 4.2.20.8 Hospital transfusion committee
- 4.2.21 Therapeutic apheresis
 - 4.2.21.1 Principles of apheresis technology
 - 4.2.21.2 Indications (ASFA Categories), risk and benefits

- 4.2.21.3 Replacement fluids
- 4.2.21.4 Monitoring of patient and central venous canula
- 4.2.22 Stem cell collection & processing
 - 4.2.22.1 Donor preparative regimen
 - 4.2.22.2 Collection techniques and complications
 - 4.2.22.3 Cell count targets and engraftment monitoring
 - 4.2.22.4 Processing and storage
 - 4.2.22.5 Collection & processing
- 4.2.23 Regulatory / accreditation agencies
 - 4.2.23.1 Drugs and cosmetics act of India
 - 4.2.23.2 Licensing requirements
 - 4.2.23.3 National blood policy
 - 4.2.23.4 ISO, JCI/NABH, GMP, AABB, CAP/NABL
 - 4.2.23.5 Inventory management
 - 4.2.23.6 Donor notification and counselling

5 Departmental rotations & other postings

The training programme should be designed to enable the student to acquire a capacity to learn and investigate for himself, to synthesize and integrate a set of facts and develop a faculty to reason. The curricular programmes and scheduling of postings must provide the student with opportunities to embrace the above broad objectives. *Much of the learning is to be accomplished by the student himself. Interactive discussions are to be preferred over didactic sessions.* The student must blend as an integral part of the activities of an academic department that usually revolves around three equally important basic functions of teaching, research and service. As mentioned earlier the emphasis is recommended under a residency programme or learning while serving/working.

5.1 Teaching/learning activities that may be employed.

- Departmental didactics
- Rotation specific training at different sections (5.2.1.1)/allied rotation departments (5.2.1.3)
- Laboratory-work.
- Use and maintenance of equipment.
- Maintenance of records.
- Teaching undergraduates and paramedical staff.
- Clinico-pathological conferences
- Combined Grand rounds
- Journal Clubs
- Intradepartmental and interdepartmental conferences, case discussions.
- Research Presentation and review of research work.
- Guest and in-house lectures.
- Conferences, Seminars, Continuing Medical Education (CME) Programmes.
- Regional or national transfusion meetings, workshops, conferences, webinars, and audio-conferences: Students should be encouraged to present abstracts in meeting of the ISBTI and ISHTM.
- Research Projects: Students should be given the opportunity to participate in applied or basic science projects related to transfusion in addition to their MD dissertation.

5.A. For the purpose of thesis/dissertation, as far as possible, each individual must be given the freedom of choice of his/her own subjects he would like to study. He/she should be given an opportunity to apprise himself/herself with topics of current research interests of each member of the faculty. In case the student does not have a preference of his/her own, topics are to be suggested by the faculty who ensure that there is generally an equitable distribution of the postgraduates among the faculty. It is obvious that the thesis or dissertation will be on a topic on which there is general interest, expertise and facilities with the faculty. Interdepartmental collaboration should be encouraged to widen the scope and outlook of the research proposal and training.

5.2 Structured Training Programme

A structured scheme of training is recommended so that every student is exposed to different aspects of the subject and acquires sufficient knowledge and skill as expected from the course. The method by which this is done may vary from institution to institution. However, it is suggested that one senior member of the faculty be given the chief responsibility for organising and coordinating this programme and any enquiries may be made or assistance taken, if necessary, from him/her. The three-year training programme for the M.D. degree may be arranged in the form of postings to different assignments/ laboratories for specified periods as outlined below. The period of such assignments/postings is recommended for 35 months. Posting schedules may be modified depending on needs, feasibility and exigencies. It is appreciated that individual institutions may find it convenient to follow a different pattern of posting.

5.2.1 Theoretical training

5.2.1.1 Didactic lectures

Typical examples of transfusion medicine didactic lectures

Lecture topic	Content
	<p>Blood component therapy Various kinds of blood components, methods of preparation, composition of components, storage and cross matching requirements, component modification, special components</p>
	<p>Adverse effects of transfusion Recognition, testing, treatment, prevention strategies for (Immune) hemolytic transfusion reaction, allergic anaphylactoid reaction</p>
	<p>Adverse effects of transfusion Recognition, testing, treatment, prevention of septic reactions, TRALI, TAGvHD, PTP, iron overload</p>
	<p>Transfusion transmitted infection Risk, clinical significance, testing, prevention strategies, for viruses, parasites, prions</p>
	<p>Apheresis Principles, techniques, instrumentation for donor and therapeutic apheresis, indications and treatment plan for therapeutic apheresis,</p>
	<p>Red cell antibody detection Perform and how to interpret antibody panels with single / multiple antibodies, evaluation of auto antibodies</p>

5.2.1.2 Rotations in department

Typical examples of department rotation of students

Title	Content of training activities	Learning objective
Orientation [1 month]	Brief orientation to computer system, blood bank activities, teaching program	Be conversant with computer system & operation of blood bank activities

Blood donation [3 months]	Donor recruitment & motivation, Donor selection Phlebotomy, Post donation care of donor, Out door blood donation	Should be able to select the donor, perform phlebotomy with aseptic precautions, and manage donor reactions
Apheresis – donor and therapeutic [4 months]	Access evaluation, donor suitability, selection of machine, product manipulation, QC of product, donor observation for adverse effects and its management Indications, contra indications, replacement fluids, frequency, monitoring of TPE	Should be able to perform the procedure independently, obtain quality product and manage any adverse effects Should be able to select proper patient, machine, plan TPE, select replacement fluids and monitor the patient
Component preparation & QC [4 months]	Preparation of blood components. Product manipulation such as Leucocyte removal or Irradiation. Storage & quality control	Should be able to understand factors affecting quality of components,
Immunohaematology [4 months]	Diagnosis & transfusion support in AIHA, PNH Evaluation of transfusion reaction. Investigations in antenatal serology. ABO-Rh typing, antibody screening, identification, evaluation of positive DAT	Should be able to interpret immune hematological tests. Should be able to provide consultation to physicians regarding transfusion management
Pretransfusion testing & cross match [5 months]	Investigation of difficult cross match, formal consultation on transfusion support in complex cases, checking indications & dosage for blood components, emergent issue of blood, transfusion in special cases such as massive transfusion, organ transplantation, platelet refractoriness.	Should be able to provide consultation on transfusion therapy. Should be able to resolve difficult & complex cross matching problems. Ensure appropriate and judicious use of blood and components
Transfusion Transmitted infection screening [5 months]	Screening for various markers such as HIV, HCV, HBsAg, Syphilis. Methodology such as Elisa, spot, rapid, automated analyzer NAT techniques such as PCR, TMA. Laboratory safety	Should be able to understand blood screening principles and disposal of reactive units. Should be able to validate ELISA, maintain QC
Quality control/ records [2 months]	Quality control of components, equipment, reagents. Quality assurance. Development of documents, SOPs, Regulatory compliance	Should be able to understand QC principles, Recognize common management & regulatory issues, identify

		management strategies
PBSCT [1 month]	Processing, storage, thawing, infusion of PBSC. Immuno-hematological monitoring of ABO mismatch transplants, Transfusion support – irradiation, CMV issues	Describe common procedures and basic concepts behind PBSC processing and cellular product therapies.
Elective [1 month]		

5.2.1.3 Training in allied departments :

Students should be sent for training for 6 months in allied laboratory and clinical departments.

Laboratory areas subjects :

Hematology & Coagulation labs: (1 month in 2nd Year and 1 month in 3rd Year)

- Complete hemogram
- Work up of hemolytic anemias
- Reading peripheral smear
- CD4/ CD8 / CD 34 counts using flow cytometry
- Bone marrow aspiration
- Coagulation work up
- Platelet function testing

Microbiology Laboratory (15 Days in 2nd year)

- Gram Staining & wet mounts
- Blood Culture

Transplant Immunology & Molecular Labs (external rotation, 2 weeks in 3rd Year)

- HLA typing
- Isolation of lymphocytes
- Immunofluorescence
- Special molecular techniques

Clinical Department subjects :

- Day care/IV therapy center (1 month)
- Transfusion support for thalassaemia, haemophilia, leukemia,
- Bedside Transfusion Clinical Postings (1 months)
- Platelet transfusion therapy and its monitoring
- Neonatal exchange transfusion
- Bed side management of transfusion reactions
- Intraoperative hemodilution, Use of Cell saver, Intraoperative Blood salvage

5A.Extramural postings to reputed institutions or to other institutions to learn techniques not available in the parent institution and also to acquire knowledge.

6 Dissertation & Research

Thesis will be done as per institutional guidelines.

7.Assessment

Formative and Summative—as per Institutional Guidelines.

A standardised scheme of evaluation is necessary to train candidates in any teaching programme. Both formative and summative evaluations are therefore mandatory.

Reading Material

In any postgraduate course reading should not be limited only to the subject of specialisation. One is expected to acquire as much theoretical and practical knowledge as possible. There can be no set guidelines in this regard. Students must be encouraged to utilise the Internet and similar information technologies to further their knowledge and to supplement conventional reading.

The following is an incomplete list of reading material that may be helpful to a postgraduate student of Transfusion Medicine. The habit of referring to current literature and the method of searching for literature must be made a mandatory component of the training.

Books

1. **AABB Technical Manual** Latest edition (e.g. 18th edition as of 2016)
2. **Mollison's Blood Transfusion in Clinical Medicine.** Klein, Harvey G., and David J. Anstee. John Wiley & Sons, 2013.
3. **Rossi's Principles of Transfusion Medicine.** Simon, Toby L., Jeffrey McCullough, Edward L. Snyder, Bjarte G. Solheim, and Ronald G. Strauss. John Wiley & Sons, 2016.
4. **Apheresis: Principles and Practice.** McLeod, Bruce C. AABB Press, 2010.
5. **Modern Blood Banking and Transfusion Practices.** Harmening, Denise M. F.A. Davis, 2012.
6. **Judd's Methods in Immunohematology.** Judd, W. John, Susan T. Johnson, and Jill Storry. AABB Press, 2008.
7. **Handbook of Pediatric Transfusion Medicine.** Hillyer, Christopher D., Christopher Hillyer, Ronald Strauss, and Naomi Luban. Academic Press, 2004.
8. Marder, Victor J., William C. Aird, Joel S. Bennett, Sam Schulman, and Gilbert C. White II. **Hemostasis and Thrombosis: Basic Principles and Clinical Practice.** Lippincott Williams & Wilkins, 2012.
9. **Clinical Diagnosis and Management by Laboratory Methods, Henry JB,** WB Saunders.(Indian Edition, Eastern Press, Bangalore).
10. **Compendium Of Transfusion Medicine.** R.N.Makroo, Dr. Career Publications, 2009.

Additional recommended books:

- **Human Blood Groups.** Daniels, Geoff. John Wiley & Sons, 2013.
- **Practical Haematology,** Dacie JV, Lewis SM, Churchill Livingstone, Edinburgh
- Forman, Stephen J., Robert S. Negrin, Joseph H. Antin, and Frederick R. Appelbaum. **Thomas' Hematopoietic Cell Transplantation,** 2 Volume Set. John

- Wiley & Sons, 2015.
- Shaz, Beth H., Christopher D. Hillyer, Mikhail Roshal, and Charles S. Abrams. *Transfusion Medicine and Hemostasis: Clinical and Laboratory Aspects*. Newnes, 2013.
 - Latest edition of AABB Standards for Blood Banks and Transfusion Services (eg 30th Edition as of 2016). American Association of Blood Banks.
 - Hillyer, Christopher D. *Blood Banking and Transfusion Medicine: Basic Principles & Practice*. Elsevier Health Sciences, 2007.
 - King, Karen Eileen, and Nicholas Bandarenko. *Blood Transfusion Therapy: A Physician's Handbook*. Amer Assn of Blood Banks, 2014.
 - Roseff, Susan D. *Pediatric Transfusion: A Physician's Handbook*. AABB, 2009.
 - Daniels, Geoff, and Imelda Bromilow. *Essential Guide to Blood Groups*. John Wiley & Sons, 2013.
 - Michelson, Alan D. *Platelets*. Academic Press, 2012.
 - Murphy, Michael F., and Derwood H. Pamphilon. *Practical Transfusion Medicine*. John Wiley & Sons, 2013.
 - Blaney, Kathy D., and Paula R. Howard. *Basic & Applied Concepts of Blood Banking and Transfusion Practices*. Elsevier Health Sciences, 2013.
 - Committee, Standards Program. *Standards for Immunohematology Reference Laboratories*. S. Karger AG, 2005.
 - Barbara, John A. J., and Marcela Contreras. *Transfusion Microbiology*. Cambridge University Press, 2008.
 - Bhardwaj, Kanchan. *Transfusion Update*. Jaypee Brothers, Medical Publishers Pvt. Limited, 2015.
 - Blackall, D. P., P. I. Figueroa, and J. L. Winters. *Transfusion Medicine: Self-Assessment and Review*. Karger, S, 2009.
 - Malik, Vijay, and Elizabeth Verkey. *Law Relating to Drugs and Cosmetics: Containing Drugs and Cosmetics ACT, 1940, Drugs and Cosmetics Rules, 1945, Along with Drugs (Prices Control) Order, 2013, National Pharmaceuticals Pricing Policy, 2012 (NPPP-2012), Pharmacy ACT, 1948, Poisons ACT, 1919, Drugs and Magic Remedies (Objectionable Advertisements) ACT, 1954, and Other Allied Acts and Rules Etc. with Information on Herbal Formulations, Cosmetics and Extracts, Etc.* Eastern Book Company, 2013.
 - *Step by Step Blood Transfusion Services*. Jaypee Brothers Publishers, 2006.
 - Rodey, Glenn. *HLA beyond Tears Introduction to Human Histocompatibility*. 2nd ed edition. Distributed by Pel-Freez, 2000.
 - Seeber, Petra, and Aryeh Shander. *Basics of Blood Management*. John Wiley & Sons, 2012.
 - Weinstein, Sharon M., and Mary E. Hagle. *Plumer's Principles and Practice of Infusion Therapy*. Lippincott Williams & Wilkins, 2014.
 - *Postgraduate Hematology Hoffbrand AV, Lewis SM, Tuddenham EGD*, Butterworth Heinemann, Oxford

Journals and Periodicals

1. Transfusion
2. Vox Sanguinis
3. Transfusion medicine review

4. Transfusion Medicine
5. Transfusion Science
6. Journal of clinical apheresis
7. The American Journal of Hematology

8. The American Journal of Clinical Pathology

9. British Journal of Haematology

10. Blood

The list of journals is incomplete. It is also expected that the students make it a habit to read other journals. Further Journals such as Lancet, New England Journal of Medicine, Nature, Science etc. are a must for every postgraduate student who wishes to keep abreast with what is new in medical science.

A logbook should be maintained recording the duration of posting, the period of absence, if any, skills performed, and remarks if any by the teacher/faculty member. The logbook should also record journal clubs, seminars attended and partaken as well as undergraduate teaching activities the candidate has participated.