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MD IMMUNO HAEMATOLOGY AND BLOOD TRANSFUSION

CURRICULUM

MD Immuno Haematology and Blood Transfusion

1. Preamble

The goals of MD Immuno Haematology and Blood transfusion course is to produce a Transfusion medicine 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.

Immuno Haematology and Blood transfusion 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 Immunohematology, coagulation, HLA, TTI testing, (e) Motivating and counseling 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 Immuno Haematology and Blood Transfusion.
- 2.2** To make the candidate competent to become consultants and teachers in Immuno Haematology and Blood transfusion/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.
- 3.1.6. Section wise cognitive domain**

Organisation of Transfusion Services/ Blood donation centre

1. Acquire knowledge of the clinical, socio-behavioural, and fundamental biomedical sciences relevant to effectively and ethically provide medical supervision to operate blood donor centres and/or blood transfusion laboratories.
2. Acquire knowledge on blood donors - selection, donation, and testing, including process of allogeneic blood donation, including the medical history, donation process, adverse effects, and donor testing.
3. Identify appropriate laboratory screening investigations for blood donors, including interpreting virology and microbiology test results.
4. Be able to identify relevant scientific information to advise on introduction and implementation of new screening options for blood donors and donations.
5. Acquire knowledge of good manufacturing practice (GMP) with respect to processing blood donations and the manufacture and distribution of blood components, products, plasma derivatives, recombinant products and alternatives.
6. Acquire knowledge on equipment procurement, maintenance, performance, calibration, QC procedures, related to Transfusion Medicine,
7. Acquire knowledge on the establishment of Rare blood group registry,
8. Acquire competence to use apheresis technology for apheresis donations and for therapeutic purposes like plasma exchange, red cell exchange, stem cell collections, granulocyte apheresis
9. Acquire competence regarding ethical practices and the process of confidentiality – both patient and donor confidentiality

Transfusion transmitted infections

1. Acquire competence on appropriate strategies for blood safety with emphasis on TTI testing
2. Be able to provide advice on the implementation of enhanced technologies for blood safety including NAT, Pathogen inactivation technologies.

Immunohaematology

1. Acquire competence to evaluate data, interpret and resolve discrepant results in ABO/Rh blood grouping and pre-transfusion testing.
2. Be able to select appropriate investigative tools to resolve serological problems encountered during compatibility testing, including molecular and genetic testing and interpret them appropriately in the clinical context.
3. Acquire competence to provide immune-pharmacological evaluation and transfusion support to patient with disorders like thalassemia, Immune hemolytic anaemia, transfusion reactions, Abo mismatched transplants, exchange transfusions and intrauterine transfusions.
4. Be able to advise on the introduction of new diagnostic options in the immune-hematology laboratory.
5. Demonstrate knowledge of Granulocyte and platelet antigen system and antibodies and approach to the laboratory evaluation of patient with anti-red cell/anti-platelet/ anti granulocyte antibodies and their clinical implications.

Clinical Transfusion therapy

1. Acquire competence to incorporate principles of blood safety and transfusion safety in all the processes in the blood centre.
2. Acquire competence to effectively manage blood inventory.
3. Acquire competence to implement principles of rational use of blood and patient blood management.
4. Acquire competence to investigate transfusion – induced reactions.
5. Acquire knowledge to Identify and plan transfusion requirements to support the various types of transplantation programs,
6. Acquire competence to provide transfusion support to cases with massive blood loss.

Hematology

1. Acquire competence to evaluate a case of anaemia with the help of appropriate laboratory investigations in a logical and stepwise manner.
2. Acquire competence to evaluate a patient showing an abnormal bleeding tendency with the help of appropriate set of laboratory investigations in a logical and stepwise manner.
3. Acquire competence to evaluate a patient with suspected leukaemia /bone marrow failure syndrome with the help of appropriate a battery of laboratory investigations in a logical and stepwise manner.
4. Acquire knowledge on the role of various diagnostic modalities including interpretation of Hemogram, Bone marrow aspirate and biopsy, screening and specialised coagulation tests, Hb electrophoresis and HPLC, flow cytometry, genetic tests like karyotyping and FISH in the diagnosis of various haematological disorders.

Molecular diagnostics

1. Acquire knowledge of the science of molecular genetics, including nucleic acid structure and function, mutations/variants, and use appropriate/accurate descriptive nomenclature.
2. Acquire knowledge of standard molecular laboratory techniques.
3. Acquire technical proficiency in nucleic acid extraction, electrophoresis, qualitative and quantitative amplification technologies.
4. Be able to understand the clinical implications, methodology and limitations of testing for a wide range of clinical disorders, including malignant and non-malignant hemopoietic disorders, infectious diseases, coagulopathies, and inherited genetic disorders.

Histocompatibility

1. Acquire competence to interpret the basic HLA testing procedures including HLA typing and cross-match.
2. Acquire working proficiency of the principle, workflow, instrumentation and troubleshooting of technologies commonly used in histocompatibility laboratories including molecular techniques like PCR, SSP and SSOP for HLA typing and cross-matching by CDC and flow cytometry.
3. Acquire familiarity with Luminex based assays, Sanger sequencing, NGS and fragment analysis.
4. Be competent to explain and discuss the implications of HLA matching and mismatches in solid organ and bone marrow/stem cell transplantation.
5. Be competent to discuss the factors involved in donor selection for bone marrow/solid organ transplantation.
6. Acquire competence to judiciously use available cross-matches and antibody detection tests in different clinical scenarios.
7. Acquire knowledge and be able to describe the role of the HLA system as it pertains to transplantation, the methods to select potential donors and recipients, and the role and function of various stem cell donor registries.
8. Acquire knowledge and competence to understand the HLA associations with disease.
9. Acquire knowledge of the policies and procedures regarding the collection and storage of hematopoietic stem cells from various sources.
10. Acquire an understanding of relevant issues regarding solid organ procurement and transplantation.

Information management, automation, and regulatory systems

1. Apply the knowledge of applicable and relevant regulatory requirements in terms of documentation, process control for the functioning of blood centre.
2. Comply with the requirements of licensing, regulatory and accreditation bodies.

3. Assess the need for automation, evaluate and implement automation optimally for various activities at the blood centre.
4. Acquire knowledge and be able to apply the principles of quality management system, quality control and quality assurance at all levels of functioning at the blood centre and for all the activities.
5. Acquire knowledge of basic principles of laboratory management, including QC, QA, test validation, budgeting, personnel requirements, regulatory agencies and requirements, ethical issues, and laboratory and patient safety.
6. Acquire knowledge and be able to manage the operations of blood bank information system for effective data management with appropriate integration of informatics into the testing laboratories ensuring data protection.

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 do donor selection of whole blood and apheresis donors, phlebotomy, pre and post donation counseling
- 3.2.2. Proficiency in performing blood component preparation, modified blood components, specialized components and its storage
- 3.2.3. Proficiency in performing all immunohematological work ups including elution, secretor status, antibody identification etc.,
- 3.2.4. Able to carry out the investigative or therapeutic procedures of Transfusion Medicine
- 3.2.5. Should be able to interpret test results and effectively correlate clinical information
- 3.2.6. 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.
- 3.2.7. Should learn how to organize and present complex information to their colleagues.
- 3.2.8. Carry out research; maintain accurate records of research data or tests results systematically
- 3.2.9. Able to systematically write a paper and publish in a journal.
- 3.2.10. Able to present a paper in a conference through an oral presentation and poster presentation.
- 3.2.11. Should upgrade the scientific knowledge by continuing medical education
- 3.2.12. Should be able to identify problems in the laboratory and offer solutions thereof so that a high order of quality control is maintained.
- 3.2.13. Organize training program for manpower development in the field.
- 3.2.14. Acquire competence to use apheresis technology for apheresis donations and for therapeutic purposes like plasma exchange, red cell exchange, stem cell collections, granulocyte apheresis
- 3.2.15. Acquire competence regarding ethical practices and the process of confidentiality – both patient and donor confidentiality
- 3.2.16. Acquire competence on appropriate strategies for blood safety with emphasis on TTI testing
- 3.2.17. Be able to provide advice on the implementation of enhanced technologies for blood safety including NAT, Pathogen inactivation technologies.
- 3.2.18. Acquire competence to evaluate data, interpret and resolve discrepant results in ABO/Rh blood grouping and pre-transfusion testing.
- 3.2.19. Be able to select appropriate investigative tools to resolve serological problems encountered during compatibility testing, including molecular and genetic testing and interpret them appropriately in the clinical context.
- 3.2.20. Acquire competence to provide immune-pharmacological evaluation and transfusion support to patient with disorders like thalassemia, Immune hemolytic anaemia, transfusion reactions, ABO mismatched transplants, exchange transfusions and intrauterine transfusions.
- 3.2.21. Be able to advise on the introduction of new diagnostic options in the immune-

hematology laboratory.

3.2.22. Section wise psychomotor domain:

Immunohaematology:

1. ABO and Rh D blood grouping - forward and reverse grouping by tube method and by gel card and other methods.
2. Preparation of cell suspensions of appropriate concentration following cell washing techniques, correctly, grade and interpret antibody-antigen reactions according to the established criteria.
3. Interpret and resolve discrepant results in pre-transfusion testing, ABO/RhD grouping, red cell antibody screen, and antibody identification.
4. Cross match by conventional tube method and other advanced technologies of blood components as per department SOP.
5. Perform direct and indirect antiglobulin test on appropriate specimens, grading and recording the results appropriately with the appropriate controls and "check cells".
6. Perform trouble shoot in Antiglobulin testing by identifying sources of error in antiglobulin testing and resolve the errors in testing
7. Perform antibody identification procedures by the use of appropriate red cell panels and correctly interpret the results.
8. Identification of 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.
9. Perform various immune-hematological tests including: Titration of antisera- Anti D and Anti A and Anti B, Elution, Adsorption, Minor blood group typing, Saliva Inhibition Test, Resolution of ABO discrepancy and interpret them
10. Preparation of appropriate reagents required for the specialized tests performed in Immunohematology lab, eg., Reagents required for Elution testing, Reagents required for DTT treatment, Reagents required for the Enzyme treatment.
11. Be able to select suitable unit/s of blood for a patient with autoimmune haemolytic anaemia
12. Perform Quality Control tests for immunohematology reagents and interpret the results thereof.
13. Perform appropriate tests for transfusion reactions, evaluate them and recommend treatment plans for management.
14. Conduct evaluation for irregular antibodies that are clinically significant in pregnancy and make appropriate recommendations for blood component transfusion.

Transfusion transmissible Infections

1. Perform blood donor screening tests for transfusion-transmissible infections (TTIs) as per departmental SOP.
2. Preparation and interpretation of *Levey-Jennings* (LJ) Chart and root cause analysis (RCA) and Corrective and Preventive action (CAPA) as and when required.
3. Perform non-treponemal and treponemal antibody tests for diagnose of syphilis and interpret the data.
4. Acquire competence for proper handling and disposal of biohazardous material as per regulatory requirements.
5. Perform Gram staining of biological fluids.
6. Perform Quality control testing of reagents and kits used for serological tests.
7. Perform peripheral blood smear staining and identification of malarial parasite.
8. Perform screening for malaria by various testing methods.

Blood donation

1. Perform Hb estimation by various methods including Spectrophotometric and colorimetric techniques.
2. Organise outdoor blood donation camps.
3. Motivate blood donors / organizers for blood donation.
4. Conduct donor screening based on eligibility criteria for whole blood donation and apheresis donation.

5. Collect whole blood for preparation of blood components for transfusion.
6. Prepare the phlebotomy site.
7. Evaluate and manage adverse reactions associated with blood donation.
8. Perform biomedical waste disposal as per protocols.
9. Prepare blood components such as PRBC, FFP, Platelet concentrate and cryoprecipitate by centrifugation technique and by buffy coat technique.
10. Perform Quality Control (QC) on the blood components and take corrective action to rectify failure of QC.
11. Conduct Apheresis procedures like plateletpheresis and plasmapheresis.

Hematology

1. Perform Hb estimation by various methods and interpret the complete hemogram.
2. Prepare stained peripheral blood smear and interpret disease conditions like nutritional (Iron deficiency/Vit B12 and Folic acid deficiency) anemia, Haemolytic anaemia (Immune, Sickle Cell, Thalassemia, Microangiopathic), acute and chronic leukaemia, identification of Hemoparasites.
3. Perform coagulation tests like prothrombin time, activated partial thromboplastin time (APTT), fibrinogen assay, thrombin time, mixing tests of PT and APTT, factor assays and interpret the results.
4. Perform point-of-care testing for hemostasis including ROTEM/TEG and interpret the data.
5. Interpret Hb electrophoresis data.

Molecular diagnosis and HLA typing

1. Perform basic molecular laboratory techniques, such as nucleic acid extraction, both manual and automated, and techniques for quality assessment of DNA and troubleshoot in the event of a technical problem
2. Interpret the results of various tests of HLA typing.
3. Interpret data of HLA cross-matching and HLA antibody detection assays, both by cell based and solid phase methods.

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

Skill level I

- 4.1.2.1 Understand the basic physiology and biochemistry of red cells, platelets and leukocytes in terms of their kinetics, function and life span.
- 4.1.2.2 Understand hemoglobin structure, synthesis, function and degradation.
- 4.1.2.3 Know the membrane structure and function of red cells, platelets and leukocytes and be able to apply their implication in transfusion medicine
- 4.1.2.4 Understand the principles of hemoglobin screening
- 4.1.2.5 Describe iron and bilirubin metabolism
- 4.1.2.6 Understand the physiology of hemostasis with regard role of platelets, coagulation pathway and fibrinolysis
- 4.1.2.7 Understand the pathophysiology of thrombocytopenia and thrombocytosis
- 4.1.2.8 Know the pathophysiology and laboratory features of intravascular and extravascular hemolysis.
- 4.1.2.9 Develop basic understanding of hemostatic and thrombotic disorders:
- 4.1.2.10 Understand the coagulopathy of liver disease;
- 4.1.2.11 Understand the pathophysiology of vitamin K deficiency and antagonism;
- 4.1.2.12 Understand the laboratory evaluation of disseminated intravascular coagulation.
- 4.1.2.13 Understand the pathophysiology of the hemophilias (A, B, and C)

Skill level II

- 4.1.2.14 Understand hemodynamic of blood flow, estimation of blood volume and be able to interpret the application of radionuclides tagging for blood volume estimation
- 4.1.2.15 Understand the pathophysiology of immune thrombocytopenia and thrombotic thrombocytopenic purpura.
- 4.1.2.16 Demonstrate competency in taking a bleeding history.

- 4.1.2.17 Understand the general principles & clinical utility of platelet function testing.
- 4.1.2.18 Understand the clinical utility of coagulation and thrombosis testing.
- 4.1.2.19 Understand the general principles of screening coagulation tests (e.g., prothrombin time, activated partial thromboplastin time, fibrinogen, and thrombin time).
- 4.1.2.20 Understand the International Normalized Ratio derivation and its clinical significance.
- 4.1.2.21 Understand role of point of care testing in coagulation
- 4.1.2.22 Understand and interpret TEG/ROTEM/Sonoclot data
- 4.1.2.23 Understand work up of different types of Von Willebrand disease
- 4.1.2.24 Understand how to work up and monitor patients on different combinations of anticoagulation and platelet inhibition.

4.1.3 Blood Collection/Blood Center/Component Processing Skill

level I

- 4.1.3.1 Acquire knowledge of the clinical, socio-behavioural, and fundamental biomedical sciences relevant to effectively and ethically provide medical supervision to operate blood donor centres and/or blood transfusion laboratories.
- 4.1.3.2 Describe the factors that influence the motivation of volunteers to donate blood
- 4.1.3.3 Demonstrate professionalism in interactions with prospective donors.
- 4.1.3.4 Be able to know the clinical relevance of directed donation
- 4.1.3.5 Compare and contrast the eligibility requirements for allogeneic, autologous & apheresis blood donations.
- 4.1.3.6 Understand various types of autologous blood collection and their application in clinical transfusion service
- 4.1.3.7 Demonstrate proficiency in collection of whole blood with regard to preparation of phlebotomy site, proper volume and sample collection
- 4.1.3.8 Demonstrate proficiency in evaluating and treating adverse reactions associated with blood donation/phlebotomy (whole blood and apheresis donations).
- 4.1.3.9 Understand the factors influencing quality of blood bag for whole blood collection
- 4.1.3.10 Demonstrate the proficiency in organization of out door blood donation camp and be able to understand importance of cold chain maintenance.
- 4.1.3.11 Demonstrate knowledge of the indications for therapeutic phlebotomy.
- 4.1.3.12 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.
- 4.1.3.13 Understand the process of platelepheresis
- 4.1.3.14 Summarize the steps in blood component preparation by different methods
- 4.1.3.15 Know various factors affecting the quality of blood components
- 4.1.3.16 Understand the significance of storage of blood components at appropriate temperature and demonstrate proficiency in compatibility, labeling requirements of various components

Skill Level II

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

4.1.4 Therapeutic Apheresis

Skill Level I

- 4.1.4.1 Summarize the principles of apheresis technology, including centrifugation, filtration, and immunoadsorption.
- 4.1.4.2 Demonstrate knowledge of the indications for therapeutic apheresis and of the appropriate replacement fluids to be used in various situations.
- 4.1.4.3 Demonstrate proficiency in evaluating and preparing patients for therapeutic apheresis,

including discussion with the patient of the risks and benefits associated with apheresis procedures.

- 4.1.4.4 Communicate effectively with clinicians regarding emergent or scheduled therapeutic apheresis procedures through conversations and writing of consult notes

Skill Level II

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

4.1.5 Transfusion transmitted infection serology

Skill Level I

- 4.1.5.1 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,
- 4.1.5.2 Understand and be able to interpret nontreponemal and treponemal antibody tests used to diagnose syphilis.
- 4.1.5.3 Compare & contrast various methodologies such as ELISA, rapid & chemiluminescence used in screening of transfusion transmitted infections
- 4.1.5.4 Demonstrate proficiency in proper disposal of bio hazardous material as per recommended standards

Skill level II

- 4.1.5.5 Understand the feasibility of NAT in Indian blood transfusion services
- 4.1.5.6 Demonstrate proficiency in the preparation and use of internal control in transfusion transmitted infection screening.
- 4.1.5.7 Perform and interpret various testing platforms related to TTI
- 4.1.5.8 Preparation and interpretation of *Levey-Jennings* (LJ) Chart and root cause analysis (RCA) and Corrective and Preventive action (CAPA) as and when required.

4.1.6 Clinical Transfusion Service

Skill Level I

- 4.1.6.1 Demonstrate knowledge of the principles of patient/ unit identification and pretransfusion testing, including ABO/Rh testing, RBC antibody screen, and antibody identification.
- 4.1.6.2 Compare and contrast conventional cross matching versus type and screen using various advanced technologies such as gel, solid phase, and column agglutination.
- 4.1.6.3 Recognize the symptoms and signs of hemolytic and nonhemolytic transfusion reactions and demonstrate knowledge of the pathophysiology, treatment, and prevention of these complications.
- 4.1.6.4 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.
- 4.1.6.5 Choose appropriate blood components and derivatives based on a thorough knowledge of the indications for transfusion.
- 4.1.6.6 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.
- 4.1.6.7 Demonstrate proficiency in preparation and transfusion of blood for intra uterine transfusion / exchange transfusion.
- 4.1.6.8 Demonstrate knowledge of the pathophysiology and treatment of neonatal alloimmune thrombocytopenia.
- 4.1.6.9 Demonstrate proficiency in the evaluation and appropriate transfusion therapy of thrombocytopenic patients (both adult and pediatric).
- 4.1.6.10 Apply the principles of a massive transfusion protocol.
- 4.1.6.11 Demonstrate a working knowledge of the principles of hemostasis and coagulation and

proficiency in the initial treatment of patients with bleeding disorders.

- 4.1.6.12 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

- 4.1.6.13 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.
- 4.1.6.14 Demonstrate proficiency in evaluating and recommending treatment plans for complex transfusion reactions.
- 4.1.6.15 Demonstrate familiarity with the appropriate use of highly specialized blood products (e.g., granulocytes, donor lymphocyte infusions, HLA-matched platelets, and coagulation factor concentrates).
- 4.1.6.16 Demonstrate familiarity with the requirements of all applicable regulatory and accrediting agencies [e.g., DCI, NABH].
- 4.1.6.17 Demonstrate competence in the management of blood inventory and the ability to communicate effectively the hospital's needs to the blood supplier.
- 4.1.6.18 Demonstrate knowledge of various methods of blood conservation, including pre- and perioperative autologous blood collection, and approaches to "bloodless" surgery.
- 4.1.6.19 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.
- 4.1.6.20 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).
- 4.1.6.21 Develop an understanding of emerging areas of cellular therapy, including hematopoietic graft engineering and cellular immunotherapeutics.
- 4.1.6.22 Develop and understanding of blood substitutes and hematopoietic agents

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

- 4.1.7.1 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.
- 4.1.7.2 Understand training, certification, licensing, and competency assessment standards for transfusion laboratory professionals, including medical laboratory technicians.
- 4.1.7.3 Understand the importance of a comprehensive transfusion laboratory safety policy and program.
- 4.1.7.4 Understand how SOPs are used, developed, authored, and reviewed and their importance in mandatory laboratory inspection by various accrediting agencies.
- 4.1.7.5 Understand the role of quality assurance, quality management, and process improvement principles in laboratory operation and planning.
- 4.1.7.6 Be able to understand proper use of instrumentation and computerization in a transfusion laboratory

Skill Level II

- 4.1.7.7 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.
- 4.1.7.8 Compare and contrast the various means of performing blood utilization reviews.
- 4.1.7.9 Explain the logistics required in determining appropriate blood inventory for a geographic region and the process of meeting daily, weekly and monthly collection goals.
- 4.1.7.10 Demonstrate understanding of the elements of current good manufacturing practices as they apply to the collection, processing, and storage of all blood components / products

- 4.1.7.11 Understand the principles & objectives of total quality management in transfusion service including premises, personnel, instruments / reagents, biosafety and external / internal quality control.
- 4.1.7.12 Know fundamental concepts of medical statistics.
- 4.1.7.13 Understand principles of specimen collection (e.g., phlebotomy technique, safety, and specimen tubes) and specimen processing.
- 4.1.7.14 Recognize sources of preanalytical variation and the role of biological variability in laboratory assessment.

4.1.8 ADDITIONAL COMPETENCIES SPECIFIC TO TRANSFUSION MEDICINE

4.1.8.1 Patient Care

- 4.1.8.1.1 Correctly classify transfusion reactions and give appropriate treatment recommendations.
- 4.1.8.1.2 Choose appropriate cross-matching methods for various patients (e.g., electronic, immediate spin, and antiglobulin).
- 4.1.8.1.3 Recognize and appropriately refer serological evaluations that are beyond the scope of a hospital-based transfusion service/blood bank.
- 4.1.8.1.4 Correctly choose (or recommend) the appropriate blood product for patients with special needs.
- 4.1.8.1.5 Triage and screen requests for blood components appropriately during inventory shortages.
- 4.1.8.1.6 Demonstrate the ability to perform blood utilization reviews.
- 4.1.8.1.7 Perform a donor interview and exam.
- 4.1.8.1.8 Evaluate and perform initial management of whole blood and apheresis donor reactions.
- 4.1.8.1.9 Write physician orders for peripheral blood hematopoietic stem cell collections and therapeutic apheresis procedures.
- 4.1.8.1.10 Appropriately manage reactions that occur during peripheral blood hematopoietic stem cell collections or therapeutic apheresis procedures.
- 4.1.8.1.11 Be able to apply recent developments in the field from research to clinical practice such as gene therapy, proteomics, microarray etc

4.1.8.2 Medical Knowledge

- 4.1.8.2.1 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.

4.1.8.3 Practice-Based Learning and Improvement

- 4.1.8.3.1 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.

4.1.8.4 Interpersonal and Communication Skills

- 4.1.8.4.1 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	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	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 DIC) 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 counseling

5 Departmental rotations & other postings

The training programme is 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 is to provide the student with opportunities to embrace the above broad objectives. Much of the learning would be accomplished by the student himself. Interactive discussions would 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 methods: General principles

Acquisition of competencies being the keystone of doctoral medical education, such training should be skills oriented. Learning in the program, essentially autonomous and self-directed, and emanating from academic and clinical work, shall also include assisted learning. The formal sessions are meant to supplement this core effort.

All students joining the postgraduate (PG) courses shall work as full-time (junior) residents during the period of training, attending the training activity during the calendar year, and participating in all assignments and facets of the educational process. They shall maintain a log book for recording the training they have undergone, and details of the procedures done during laboratory and clinical postings in real time.

Teaching/learning activities that may be employed:

- Departmental didactics
- Rotation specific training at different sections (5.2.1.2)/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 would be given the freedom of choice of his/her own subjects he would like to study. He/she would 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 would 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 would 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 in place so that every student is exposed to different aspects of the subject and acquires sufficient knowledge and skill as expected from the course. Head of the department or any one faculty approved by the Head of the department would 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 would be arranged in the form of postings to different assignments/ laboratories for specified periods as outlined below. **Posting schedules shall be modified depending on needs, feasibility and exigencies.**

5.2.1 Theoretical training

5.2.1.1 Didactic lectures

Typical examples of transfusion medicine didactic lectures

- Blood component therapy, various kinds of blood components, methods of preparation, composition of components, storage and cross matching requirements, component

modification, special components.

- Adverse effects of transfusion recognition, testing, treatment, prevention strategies for immune hemolytic transfusion reaction, allergic/anaphylactoid reaction, septic reactions, TRALI, TA-GVHD, PTP, iron overload.
- Transfusion transmitted risk, clinical significance, testing, preventive strategies for viruses, parasites, prions.
- Donor Apheresis principles, techniques, instrumentation,
- Therapeutic apheresis indications and treatment plan.
- Red cell antibody identification, its interpretation in single/multiple antibodies, evaluation of autoantibodies.

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 asptic 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 judical 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. Immunohematological 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 would be sent for training in allied laboratory and clinical departments.

Section/Subject of Posting	Brief activity of posting	Duration in months/weeks
Laboratory hematology	Training on Peripheral blood smear, bone marrow examination, hemoglobinopathies, flowcytometry and coagulation, platelet function testing	1 month
Microbiology	Gram staining, Training on Bacterial culture, PCR for virology, knowledge on parasitology related to Blood Transfusion	2 weeks
Clinical Hematology	Management and transfusion support of thalassemia, sickle cell disease, hemophilia, coagulopathies, bleeding disorder, hematooncology patients, transplantation and AIHA etc	2 months
Transplant Immunology & molecular lab	Basics of molecular testing PCR NAT testing, Lymphocyte isolation, HLA typing, HLA crossmatch, PRA	1 month
Clinical department	Antenatal serology, IUT, neonatal transfusion practices, exchange transfusion, management of massive blood transfusion and its complications, Intraoperative hemodilution, Use of Cell saver, Intraoperative Blood salvage, bedside management of transfusion reaction, platelet transfusion therapy and its monitoring.	6 weeks
Total Duration		36 months

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

Academic activity:

1. Topic seminar- Minimum of once in every week
2. Journal club – Minimum of once in every fortnight
3. Case discussion- Minimum of once in fortnight
4. Bedside and Bench Side Practices: Minimum of once in a month

Each student is expected to present in **at least 75%** of the academic activity during his/ her total residency period.

Under graduate teaching : It is mandatory for the post graduate student to attend the undergraduate practical and take active participation in teaching/demonstration of Blood grouping serology, TTI testing and component preparation to the undergraduate, MLT and nursing students.

Entrustable professional activities as per their year of training:

Sr. No	Entrustable Professional Activities	Competencies						Expected level		
		MK	P/DC	ICS	P	PBLI	SBP	1 st year	2 nd year	3 rd Year
1	Demonstrate proficiency in selection of whole blood donors and apheresis donors.	Y	Y	Y	Y	Y	Y	2	3	4
2	Demonstrate proficiency in collection of whole blood with regard to preparation of phlebotomy site, proper volume and sample collection.	Y	Y	Y	Y	Y	Y	1	3	4
3	Demonstrate proficiency in evaluating and managing minimum adverse donor reactions	Y	Y	Y	Y	Y	Y	1	3	4
4	Proficiency in organization blood donation camps and demonstrate skills to motivate blood donors / organizers.	Y	Y	Y	Y	Y	Y	2	3	4
5	Demonstrate knowledge and proficiency in performing therapeutic phlebotomy.	Y	Y	Y	Y	Y	Y	2	3	4
6	Demonstrate competency in performing & interpretation of various methods of Hb estimation.	Y	Y	---	Y	Y	Y	2	3	4
7	Demonstrate proficiency in preparation of blood components.	Y	--	--	Y	Y	Y	2	3	4
8	Demonstrate proficiency in compatibility, labeling requirements and storage of various components	Y	Y	Y	Y	Y	Y	1	3	4
9	Demonstrate proficiency in various modifications of blood components such as irradiation, cell washing, volume depletion and leuko depletion.	Y	--	--	Y	Y	Y	2	3	4
10	Demonstrate proficiency in performing quality control tests of blood components.	Y	--	--	Y	Y	Y	1	3	4
11	Demonstrate proficiency in performing, interpretation, documentation of blood donor screening tests for TTIs.	Y	--	---	Y	Y	Y	1	2	3

12	Demonstrate proficiency in preparation and interpretation of LJ Chart and root cause analysis (RCA) and Corrective and Preventive action (CAPA).	Y	--	--	Y	Y	Y	1	2	3
13	Should be able to compare & contrast various methodologies such as ELISA, rapid & chemiluminescence used in screening of transfusion transmitted infections.	Y	--	--	Y	Y	Y	1	3	4
14	Demonstrate proficiency in the preparation and use of in-house external controls.	Y	--	--	Y	Y	Y	1	2	3
15	Demonstrate proficiency in proper handling and disposal of biohazardous material.	Y	Y	Y	Y	Y	Y	1	3	4
16	Demonstrate proficiency in preparation of cell suspensions of appropriate concentration following cell washing techniques correctly & grade and interpret antibody-antigen reactions.	Y	Y	--	Y	Y	Y	1	3	4
17	Demonstrate proficiency in performing ABO/Rh grouping in donor / patient Samples.	Y	Y	Y	Y	Y	Y	1	3	4
18	Demonstrate proficiency in performing, interpretation and resolving discrepant results in pre-transfusion testing, ABO/Rh grouping.	Y	Y	Y	Y	Y	Y	1	3	4
19	Demonstrate proficiency in performing, interpretation of red cell antibody screen, and antibody identification.	Y	Y	Y	Y	Y	Y	1	2	3
20	Should be able to perform direct and indirect antiglobulin test on appropriate specimens, grading and recording the results appropriately with the use of "check cells".	Y	Y	Y	Y	Y	Y	1	3	4
21	Demonstrate proficiency in selection of blood unit for a patient with auto immune hemolytic anemia.	Y	Y	Y	Y	Y	Y	1	2	3
22	Demonstrate proficiency in evaluating and recommending treatment plans for transfusion reactions.	Y	Y	Y	Y	Y	Y	1	3	4
23	Be able to identify irregular antibodies in pregnant patients that are clinically significant and make appropriate recommendations for blood products.	Y	Y	Y	Y	Y	Y	1	2	3

24	Demonstrate proficiency in preparation and transfusion of blood for intrauterine transfusion / exchange transfusion.	Y	Y	Y	Y	Y	Y	1	2	4
25	Demonstrate proficiency in the evaluation and appropriate transfusion therapy of thrombocytopenic patients (both adult and pediatric) including neonatal alloimmune thrombocytopenia.	Y	Y	Y	Y	Y	Y	1	2	3
26	Demonstrate proficiency in evaluating effectiveness of platelet transfusion including patient's with refractoriness to platelet transfusions.	Y	Y	Y	Y	Y	Y	1	2	3
27	Demonstrate competency in providing transfusion and immuno-hematological support to patients with solid organ and bone marrow / stem cell transplantation	Y	Y	Y	Y	Y	Y	1	2	3
28	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).	Y	Y	Y	Y	Y	Y	1	2	3
29	Demonstrate proficiency in performing molecular/ serologic HLA testing, interpretation in organ and bone marrow transplant	Y	Y	Y	Y	Y	Y	1	2	3
30	Demonstrate familiarity with the appropriate use of highly specialized blood products (e.g., granulocytes, donor lymphocyte infusions, HLA-matched platelets.	Y	Y	Y	Y	Y	Y	1	2	3
31	Demonstrate competence in the management of blood inventory and the ability to communicate effectively the hospital's needs to the blood donor recruiters, Triage and screen requests for blood components appropriately during inventory shortages.	Y	Y	Y	Y	Y	Y	1	3	4
32	Demonstrate proficiency in evaluating and preparing patients for therapeutic apheresis, including discussion with the patient of the risks and benefits associated with apheresis procedures and obtaining informed consent.	Y	Y	Y	Y	Y	Y	1	2	4

33	Should be able to perform plasma exchange including calculation & type of replacement fluid to be used and monitoring patient for complications and efficacy of the procedure.	Y	Y	Y	Y	Y	Y	1	2	3
34	Demonstrate proficiency in evaluating and treating adverse reactions associated with therapeutic apheresis.	Y	Y	Y	Y	Y	Y	1	2	3
35	Demonstrate proficiency in evaluating and preparing donor for platelet apheresis, including discussion with the clinician and obtaining informed consent.	Y	Y	Y	Y	Y	Y	1	2	4
36	Demonstrate proficiency in the treatment of patients using specialized methods (e.g., photopheresis and immunoadsorption columns)	Y	Y	Y	Y	Y	Y	1	2	3
37	Should be able to prepare, stain and interpret peripheral smear and interpret routine hematological investigations like Hb, TLC, DLC, ESR PCV, Blood indices.	Y	--	--	Y	Y	Y	1	2	4
38	Should be able to perform and interpret coagulation profile testing like PT, APTT, Fibrinogen etc	Y	--	--	Y	Y	Y	1	2	3
39	Demonstrate proficiency of the use of various point-of-care tests (TEG, ROTEM) for hemostasis & recommend component therapy depending on the results.	Y	Y	Y	Y	Y	Y	1	3	4
40	Should be able to perform and interpret special investigations like Retic count, Sickling test, Osmotic fragility test, hemoglobin electrophoresis, Fetal Hemoglobin	Y	--	--	Y	Y	Y	1	2	3
41	Should be able to present oral and poster presentations, write paper in conferences	Y	Y	Y	Y	Y	Y	--	2	3
42	Should be able to teach Transfusion Medicine to undergraduates (MBBS), and allied health sciences like BSc (Nursing), BSc MLT etc	Y	Y	Y	Y	Y	Y	--	2	3
43	Demonstrate knowledge concerning the requirements and applications of all applicable regulatory and accrediting agencies. [e.g., DCGI, NABH, AABB].	Y	Y	Y	Y	Y	Y	-	2	3

Abbreviations:

MK: Medical Knowledge
P/DC: Patient /Donor care
PBLI: Problem based learning and improvement
SBP: Systems based Practice
P: Professionalism
ICS: Interpersonal and Communication skills

Level of Competence:

Level 1: Knowledge only; can observe
Level 2: Can do under strict supervision
Level 3: Can do under loose supervision
Level 4: Can do independently
Level 5: Has the expertise to teach others.

6 Assessment

Formative assessment/Internal assessment:

Internal Assessment should in reality be done everyday to assess the training and to identify the weakness as well as the strength of the candidate. Thus appropriate corrective methods can be adopted at the right time so that a well-trained and competent transfusion medicine specialist worthy of a postgraduate degree is available for the society.

Formative assessment would be continual and would assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning and ability to practice in the system. Formative assessment would be conducted covering all domains of learning including professionalism and communication skills. It would be used to provide feedback to improve learning.

6.1 Internal Assessment would be based on his/her performance in seminar presentation, case discussion, journal clubs, case work up and management, laboratory performance, oral/poster presentations, attendance at scientific meetings, CME programmes, ability to get along with colleagues, conduct with donor, patients and staff.

The following points will be considered in the scheme for evaluation of presentations.

- Topic selection
- Completeness of presentation
- Clarity and cogency of presentation
- Understanding of the subject and ability to convey the same
- Whether relevant references have been consulted
- Ability to convey points in favor and against the subject under discussion
- Proper use of audio-visual aids
- Ability to answer questions
- Time scheduling

Evaluation sheet format for academic activities is given in Annexure 1.

The following points will be considered for evaluation of Laboratory performance of the resident.

- Familiarity with the procedure,
- Setting up and performing the procedure (organizational skills),
- Appropriate specimens and reagents are obtained and utilized,
- Proper use of equipment, reagents, supplies and specimens,
- Proper labelling, handling and disposal of specimens, tubes, etc,
- Organization and performance of individual tasks,
- Completion of tests within a reasonable amount of time,

- Clean up of work area,
- Correct interpretation of results with recognition of discrepancies or abnormal results.
- Results are recorded and reported in appropriate format.

Evaluation sheet format for laboratory performance is given in Annexure 2.

Log Book: Postgraduate students should maintain a log book in the prescribed format of the work carried out by them and the training programme undergone during the period of training including details of work experience during their postings, programs implemented under supervision and those performed independently. The logbook should also record journal clubs, seminars attended and partaken as well as undergraduate teaching activities the candidate has participated. The log book will be checked and assessed periodically by the faculty members imparting the training.

Formal Internal assessment time line: It will be conducted **at the end of each semester (once in every six months)**; last assessment will be conducted one month prior to the final professional examination) in both theory and practical (subject to modification as per institutional norms notified from time to time).

Internal assessment mark distribution for each internal examination:

Theory exam - 80 marks

Practical exam- 80 marks (which includes 25 marks for the lab performance, 25 marks for academic presentations, 10 marks for Log book review, 10 marks for Thesis update review, 5 marks for attendance regularity and punctuality, 5 marks for conduct with patient/donor/staff. Total- 80 marks)

The marks of the 6 internal examinations will be averaged to 80 each for theory and practical.

The student will be assessed periodically (once in 6 months) as per categories listed in the Resident appraisal form (Annexure 3).

Summative/final examination:

Summative/final assessment will be done as per Institutional norms. Attendance required for eligibility to write final examination and percentage of marks required to get pass will be as per the Institutional norms notified from time to time.

Examination will be in three parts:

1. Thesis
2. Theory examination
3. Practical and Viva voce examination

Thesis:

Resident has to submit their thesis work well in advance before their theory and practical examination. Resident would be allowed to appear for the Theory and Practical examination only after the acceptance of the Thesis by the examiners/evaluators. Resident will be given stipulated time frame to revise their thesis if it is returned for corrections from the examiners. Institutional guidelines notified from time to time would be followed for the appointment of guides/co-guides, appointment of evaluators, time frame for the completion of thesis, components of thesis, modality of submission evaluation of thesis.

Theory examination:

There shall be four theory papers.

Paper I: Basic applied aspects related to Transfusion Medicine

Paper II: Immunohematology, Immunogenetics, Transfusion transmitted infections, applied serology

Paper III: Blood donor organisation and management, blood components, Hematology, Clinical transfusion practices

Paper IV: Recent advances in the subject, Regulatory requirements, Quality management system, Information management, Automation.

Practical and Oral/viva voce examination

Institutional guidelines notified from time to time would be followed for the appointment of internal and external examiners. Practical examination would be spread over **two days** and include various major components of the syllabus focusing mainly on the psychomotor domain. The duration of each exercise shall vary from 30 minutes to 1 hour. Each exercise or station shall be followed by Viva on the exercise.

A. Laboratory and clinical skill- Six stations including OSPE/OSCE covering all aspects of transfusion medicine. Some examples are (inclusive of but not limited to):

- Blood donor / apheresis donor selection
- Blood processing,
- Component preparation,
- Immunohematology
- Antenatal serology
- Transfusion reaction management
- Quality control of reagents, equipment, components
- Coagulation testing,
- Basic hematology tests,
- Transfusion transmitted infection screening
- Stem cell transplantation

B. Clinical case scenario based exercises (4 / candidate)

There shall be minimum 4 Hemotherapy exercise and administrative issues for each candidate. The candidate is required to make his own assessment of the problem and come out with solutions.

C. Spotters (minimum 10)

D. Thesis presentation/defense/Pedagogy: The candidate will be required to present his thesis in power point format for 10 min. The candidate will be examined on the presentation style, communication skill, slide design and content.

E. Grand Viva-voce: It would be comprehensive enough to test the resident's overall knowledge of the subject by the examiners.

7 Distribution of marks from different components of examination:

The total marks for each examination (Theory and Practical/viva-voce) will be 800.

Examination	Internal Assessment	Final Professional examination	Total
Theory	80	320	400
Practical and Viva Voce	80	320	400
Total	160	640	800

Mark distribution for final theory examination:

Paper I : 80 Marks (10 questions of 8 marks each)

Paper II : 80 Marks (10 questions of 8 marks each)

Paper III : 80 Marks (10 questions of 8 marks each)

Paper IV : 80 Marks (10 questions of 8 marks each)

Total : 320 marks

Mark distribution in practical and viva voce examination:

Components	Marks allotted	Total Marks
Long case	1 x 60	60
OSPE/OSCE	2 x 25	50
Short case	3 x 20	60
Clinical case scenario based exercises	4 x 15	60
Spotters	10 x 2	20
Thesis presentation/defense/Pedagogy	20	20
Grand Viva Voce	50	50
Total	320	320

Passing marks in theory, practical and viva voce examination: (as as per institutional norms notified from time to time)

Examination	Internal Assessment	Final Professional examination	Total	Pass marks
Theory	80	320	400	200
Practical and Viva Voce	80	320	400	200

All candidates are required to obtain a minimum of 50% in Theory and a minimum of 50% in Practical and Viva-Voce separately in order to be declared as successful / having passed the examination (subject to change as per time to time notified institutional guidelines).

8 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 is a mandatory component of the training.

Recommended Books (Latest edition)

1. Technical Manual, Mark E Brecher, AABB Bethesda, Maryland Latest edition.
2. Transfusion Medicine Technical manual, Directorate General of Health Services, Ministry of Health and Family Welfare. Govt. of India, New Delhi.
3. Mollison's Blood Transfusion in Clinical Medicine. Harvey G. Klein. David J. Anstee, Blackwell publishing, Oxford.
4. Rossi's Principles of Transfusion Medicine, T.L.Simon, W.H. Dzik, E.L.Snyder, C.P.Stowell, R.G. Strauss, Lippincott Williams and Wilkins.
5. Modern Blood Banking & Transfusion Practices, Denise M Harmening, FA Davis Company, Philadelphia.
6. Blood Transfusion Therapy, Gotschall J. L. AABB press, Maryland.
7. Donor recruitment: Tips, Techniques and Tales, Perkins S, AABB Press, Maryland.
8. Transfusion therapy: Clinical Principles and Practice, Mintz P.D. AABB Press, Maryland.
9. Blood Banking and Transfusion Medicine: Basic Principles and Practices, C.D. Hillver. L.L.Silberstejn. P.M. Ness, K.C. Anderson, Churchill Livingstone.
10. Practical Transfusion Medicine, M.F. Murphy. D.H. Pamphilton, Blackwell Science.
11. Human Blood Groups, Geoff Daniels, Blackwell Science.
12. Dacie and Lewis's Practical Hematology, S.M. Levis. BJ. Bain. I. Bales, Churchill Livingstone.
13. Apheresis: Principles and Practices, B.C. McLeod. R. Weinstein, AABB Press Bethesda, Maryland.
14. Transfusion Medicine, Jeffrey McCullough, Churchill Livingstone.
15. Applied Blood Group Serology, P.D. Issit, Anstee, D.J. Winters, Montgomery Scientific Publication.
16. National standards for blood centres and blood transfusion services, Directorate General of Health Services, Ministry of Health and Family Welfare. Govt. of India, New Delhi.
17. Immunohematology: Principles and Practices, Eva D. Quinley, Lippincott Williams and Wilkins
18. Judd's Methods in Immunohematology. Judd, W. John, Susan T. Johnson, and Jill Storry. AABB Press, (latest edition).
19. Handbook of Pediatric Transfusion Medicine. Hillyer, Christopher D., Christopher Hillyer, Ronald Strauss, and Naomi Luban. Academic Press, (latest edition).
20. Haemoglobinopathy Diagnosis. Barbara J. Bain. ISBN: 9781119579953. John Wiley & Sons Ltd.
21. Postgraduate Haematology. Hoffbrand A Victor. Butterworths.
22. Williams Hematology. Beutler Ernest. McGraw-Hill Medical Publishing, New York.

23. Hemostasis and Thrombosis: Basic Principles and Clinical Practice. Colman Robert W. Lippincott Williams & Wilkins Philadelphia.

24. Introduction to Immunohematology. Bryant Neville J. Saunders.

25. Immunohaematology- Principles and Practices. Eva Quinley. Lippincott Williams and Wilkins.

Standards and Regulatory documents

- Transfusion Medicine Technical manual, Directorate General of Health Services, Ministry of Health and Family Welfare. Govt. of India, New Delhi.
- Standards for blood transfusion services, Directorate General of Health Services, Ministry of Health and Family Welfare. Govt. of India, New Delhi.
- Drugs and Cosmetic Act 1940, Amended Drug Rules 1945
- NACO Standards for Blood Banks
- NABH Standards for Blood Banks
- NACO Standards for Storage Centres
- AABB Standards
- NACO Training Modules
- NACO Quality Management system volumes

The list of books is incomplete. It is also expected that the students make it a habit to read other relevant books.

JOURNALS:

- Transfusion
- Transfusion Medicine
- Transfusion Medicine reviews
- Blood transfusion
- Vox Sanguinis
- Journal of Clinical Apheresis
- Transfusion and Apheresis Sciences
- Blood
- Transfusion Medicine and Hemotherapy
- Asian Journal of Transfusion Sciences
- Global Journal of Transfusion Medicine
- Indian Journal of Hematology and Blood Transfusion

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.

Annexure 1:**Evaluation sheet format for academic presentations:****Name of the Resident:****Topic:****Date:**

	Elements	Score of Faculty 1	Score of Faculty 2	Score of Faculty 3	Mean Average Score
	Less than satisfactory (1-3); Satisfactory (4-6); More than satisfactory (7-9)				
1.	Topic selection				
2.	Completeness of presentation				
3.	Clarity and cogency of presentation Understanding of the subject and ability to convey the same				
4.	Whether relevant references have been consulted				
5.	Ability to convey points in favor and against the subject under discussion				
6.	Proper use of audio-visual aids				
7.	Ability to answer questions				
8.	Time scheduling				
9.	Overall performance				
10.	Any remarks/comments				
	Signature of faculty				
	All scores especially those indicative of “less than satisfactory” must be communicated to the student/candidate and his signature to be obtained. Signature of Resident				

Annexure 2:**Evaluation sheet format for laboratory performance:****Name of the Resident:****Tests performed:****Date:**

	Elements	Score of Faculty 1	Score of Faculty 2	Score of Faculty 3	Mean Average Score
	Less than satisfactory (1-3); Satisfactory (4-6); More than satisfactory (7-9)				
1.	Familiarity with the procedure				
2.	Setting up and performing the procedure (organizational skills)				
3.	Appropriate specimens and reagents are obtained and utilized				
4.	Proper use of equipment, reagents, supplies and specimens				
5.	Proper labelling, handling and disposal of specimens, tubes, etc				
6.	Organization and performance of individual tasks				
7.	Completion of tests within a reasonable amount of time				
8.	Clean up of work area				
9.	Correct interpretation of results with recognition of discrepancies or abnormal results.				
10.	Results are recorded and reported in appropriate format.				
11.	Able to answer viva questions				
12.	Overall performance				
13.	Any remarks/comments				
	Signature of faculty				
	All scores especially those indicative of "less than satisfactory" must be communicated to the student/candidate and his signature to be obtained. Signature of Resident				

Annexure 3:**Resident Appraisal format:****Name:****Assessment Period:****Posting section:**

Resident appraisal form for MD Immuno Haematology and Blood Transfusion											
	Elements	Less than satisfactory			Satisfactory			More than satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
1	Scholastic aptitude and learning										
1.1	Has knowledge appropriate for level of training										
1.2	Participation and contribution to learning activity (e.g., Journal Club, Seminars, CME etc)										
1.3	Conduct of research and other scholarly activity assigned (e.g thesis, Posters, publications etc)										
1.4	Documentation of acquisition of competence (eg Log book)										
1.5	Performance in work based assessments										
1.6	Self-directed Learning										
2	Work related to training										
2.1	Practical skills that are appropriate for the level of training										
2.2	Respect for processes and procedures in the work space										
2.3	Ability to work with other members of the team										
2.4	Participation and compliance with the quality improvement process at the work environment										
2.5	Ability to record and document work accurately and appropriate for level of training										
3	Professional attributes										
3.1	Responsibility and accountability										
3.2	Contribution to growth of learning of the team										
3.3	Conduct that is ethically appropriate and respectful at all times										
3.4	Attendance Regularity and Punctuality										
4	Over all performance										
5	Space for additional comments										
6	Disposition										
	Has this assessment pattern been discussed with the trainee?	Yes/ No									
	If not explain.										
	Name and Signature of the assessee										
	Name and Signature of the assessor										
	Date										