

Preparing for the American Board
of Pathology (ABPath)
Examination of Fundamental
Knowledge and Skills

Blood Banking/Transfusion Medicine

Content Specifications



Overview:

Blood Banking/Transfusion Medicine Content Specifications

This guide outlines the content that may appear on the American Board of Pathology Blood Banking/Transfusion Medicine Subspecialty exam. It provides a framework based on the knowledge and skills typically covered in Fellow-level training, along with applicable Core and Advanced Resident topics from residency training that the trainee is expected to know or be able to perform.

Key to Designations:

C = Core/Foundational Knowledge

AR = Advanced Resident Knowledge

F = Fellow/Advanced Practitioner Knowledge

The exam assesses the knowledge, judgment, skills, and abilities necessary to identify specific entities, properly process specimens, and diagnose and monitor diseases using methods common in the practice of Blood Banking/Transfusion Medicine. The specific diseases, tests, and concepts listed in this document are important for candidates to know, but it is not possible to create a fully comprehensive list of all the material needed for certification and effective practice. Candidates should use this guide as a reference for preparing for certification and professional practice.

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1. Clinical Practice

a. Autoimmune Hemolytic Anemia	
i. Classification, Epidemiology, and Causes	C
ii. Warm Autoimmune Hemolytic Anemia	AR
1. Pathophysiology	AR
2. Autoantibodies	AR
3. Clinical Features	AR
4. Laboratory Features	AR
5. Treatment/Transfusion	AR
6. Treatment/Pharmacologic	F
iii. Cold Hemagglutinin Disease	AR
1. Pathophysiology	AR
2. Autoantibodies	AR
3. Clinical Features	AR
4. Laboratory Features	AR
5. Treatment/Transfusion	AR
6. Treatment/Pharmacologic	F
iv. Paroxysmal Cold Hemoglobinuria	AR
1. Pathophysiology	AR
2. Autoantibodies	AR
3. Clinical Features	AR
4. Laboratory Features	AR
5. Treatment/Transfusion	AR
6. Treatment/Pharmacologic	F
v. Drug-Induced Immune Hemolytic Anemia	
1. General considerations	AR
2. Drug-Adsorption Mechanism	F
3. Drug-Dependent Antibody Mechanism	F
4. Autoimmune Induction Mechanism	F
b. Paroxysmal Nocturnal Hemoglobinuria	
i. General Considerations	AR
ii. Clinical Presentation and Course	F
iii. Causes and Pathogenesis	F
iv. Laboratory Features	F
v. Treatment-Transfusion	F
c. Anemia in Oncology Patients	C

i. Causes	C
ii. Clinical Features	C
iii. Management	
1. Growth Factors	AR
2. Transfusion Therapy	F
d. Immune Thrombocytopenia	
i. Classification, Epidemiology, and Causes	C
ii. General Tests to Investigate Thrombocytopenia	C
iii. Platelet Antibody Assays HLA/HPA	C
iv. Tests for Heparin-Induced Thrombocytopenia	C
v. Immune Thrombocytopenia	
1. Pathogenesis	C
2. Clinical Features	C
3. Laboratory Features	C
4. Treatment	C
5. Immune Thrombocytopenic Purpura in Pregnancy	AR
6. Acute Immune Thrombocytopenic Purpura of Childhood	AR
7. Chronic Immune Thrombocytopenic Purpura of Childhood	AR
8. Secondary Immune Thrombocytopenic Purpura	AR
9. Platelet Genotyping	F
vi. Drug-Induced Immune Thrombocytopenia	
1. Heparin-Induced Thrombocytopenia	C
a. Pathogenesis	C
b. Treatment and Management	C
2. Typical Drug-Induced Immune Thrombocytopenia	F
3. Atypical Drug-Induced Thrombocytopenic Purpura	F
4. Drug-Induced Thrombotic Thrombocytopenic Purpura and Hemolytic Uremic Syndrome	F
vii. Alloimmune Thrombocytopenia	
1. Platelet Alloantigens	C
a. Immunogenetic and Frequency of Alloimmune Thrombocytopenia	C
2. Neonatal Alloimmune Thrombocytopenia	
a. Pathophysiology and Clinical Features	C
b. Neonatal Treatment	AR
c. Prenatal Management	AR
3. Platelet Transfusion Refractoriness	
a. Causes, Mechanisms, and Management	C
4. Post transfusion Purpura	F
a. Pathophysiology and Clinical Features	F
b. Treatment	F
5. Passive Alloimmune Thrombocytopenia	F
6. Transplantation-Associated Alloimmune Thrombocytopenia	F
a. Hematopoietic Transplantation	F

b.	Solid Organ Transplantation	F
e.	Bleeding from Congenital and Acquired Coagulation Defects, and Antithrombotic Therapy	
i.	Liver Disease	C
1.	Pathophysiology	C
2.	Laboratory Features	C
3.	Management of Bleeding	C
ii.	Vitamin K Deficiency	C
1.	Role of Vitamin K in Hemostasis	C
2.	Hemorrhagic Disease of the Newborn	C
3.	Other Causes of Vitamin K Deficiency	C
4.	Treatment	C
iii.	Disseminated Intravascular Coagulation	C
1.	Pathophysiology	C
2.	Clinical Features	C
3.	Laboratory Features	C
4.	Treatment	C
iv.	Coagulation Factor Inhibitors	
1.	Lupus Anticoagulants	C
2.	Factor VIII Inhibitors	AR
3.	Acquired von Willebrand Syndrome	F
4.	Factor V Inhibitors	F
5.	Acquired Factor X Deficiency	F
6.	Other Coagulation Inhibitors	F
v.	Acquired Platelet Function Disorders	
1.	Drug-Induced Platelet Dysfunction	C
2.	Uremia	C
3.	Cardiopulmonary Bypass	C
vi.	Antithrombotic Therapy	
1.	Warfarin	C
2.	Heparin	C
3.	Low Molecular Weight Heparins	AR
4.	Factor Xa Inhibitors	AR
5.	Direct Thrombin Inhibitors	AR
6.	Fibrinolytic Agents	AR
vii.	Congenital Coagulopathies/Thrombophilias	
1.	von Willebrand Disease	C
2.	Factor Deficiencies (At III, Protein C, Protein S Deficiencies)	C
f.	Granulocyte Transfusion (Primary Donor Issues)	F
i.	Indications and Patient Selection	F
ii.	Donor Selection and Criteria	F
iii.	Donor Stimulation – Corticosteroids and G-CSF	F
iv.	Product Collection	F
v.	Product Storage and Transport	F

- vi. Product Selection – Special Needs F
- vii. Infusion and Monitoring F
- viii. Adverse Events (Donor and Recipient) F
- ix. Clinical Outcomes F

2. Cell and Tissue Therapy

- a. HLA Antigens and Alleles
 - i. Major Histocompatibility Complex AR
 - ii. Class I and II Antigens and Their Function AR
 - iii. Polymorphism of HLA System and Nomenclature AR
 - iv. Identification of HLA Antigens, Antibodies, and Alleles
 - 1. Serologic Methods AR
 - 2. Cellular Methods F
 - 3. Nucleic Acid-Based Methods F
 - 4. Crossmatching F
 - v. Genotypes, Phenotypes, and Haplotypes F
 - vi. Medical and Biological Significance of HLA
 - 1. Transplantation F
 - a. Hematopoietic Progenitor F
 - b. Solid Organ F
 - 2. Disease Association F
- b. Tissue Banking
 - i. Transfusion Service Support of Tissue Transplantation AR
 - ii. Human Allograft Applications F
 - iii. Tissue Donation F
 - 1. Living Donors F
 - 2. Deceased Donors F
 - 3. Referral for Donation F
 - iv. Organization of Tissue Banking in the United States F
 - v. Public Attitudes Regarding Organ and Tissue Donation F
 - vi. Tissue Transplant-Transmissible Diseases F
 - vii. Tissue Donor Suitability and Tissue Transplant Risk Reduction F
 - 1. Donor Histology Screening F
 - 2. Donor Physical Assessment F
 - 3. Tissue Recovery Methods F
 - 4. Infectious Disease Testing F
 - 5. Tissue Sterilization F
 - viii. General Principles of Tissue Preservation and Clinical Use F
 - 1. Bone F
 - 2. Cartilage, Meniscus, Tendon, Ligament & Dura Mater F
 - 3. Skin F
 - 4. Ocular Tissue F
 - 5. Cardiovascular Tissue F

6. Peripheral Nerve	F
7. Parathyroid	F
8. Reproductive Tissue F/AP	F
a. Semen	F
b. Oocytes and Embryos	F
c. Extraembryonic	F
ix. Tissue Banking and Transplantation Oversight	F
c. Adoptive Immunotherapy	
i. Immunotherapy Targets for Cancer	AR
ii. T-Cell Immunotherapy Targets for Infections	F
iii. Types of Adoptive Immunotherapy	F
1. Non-specific T-cells	F
2. Antigen-Specific T-cell Therapies	F
3. Genetically-Modified T-cells	F
iv. Approaches to Improving Cellular Immunotherapy	F
v. Adoptive Immunotherapy Regulatory Issues	F
d. Gene Therapy in Transfusion Medicine	
i. Targeted Genes	F
ii. Vector Design	F
iii. Viral Vectors	F
iv. Adeno-Associated Virus	F
v. Adenoviral Vectors	F
vi. Non-Viral Gene Therapy	F
vii. Clinical Protocols and Trials	F
e. Tissue Engineering and Regenerative Medicine	F
i. Overview	F
ii. Skin	F
iii. Blood Vessel	F
iv. Bone	F
v. Cartilage	F
vi. Urology	F
vii. Cardiac	F
viii. Corneal	F

3. RBCs and RBC Components

a. Red Cell Production and Kinetics	
i. Erythropoietin	C
1. Regulation of Production	C
2. Interaction with- and Effects on Erythroid Progenitor Cells	C
ii. Nutritional Requirements for Erythropoiesis	C
iii. Influence of Pathologic States on Erythropoiesis	C
b. Oxygen Delivery and Use of Red Cells	
i. Regulation of Systematic Oxygen Delivery	C
ii. Regulation of Regional Oxygen Delivery	C

iii.	Regulation of Oxygen Delivery in the Microcirculation	C
1.	Red Cell Transfusion and the Microcirculation	C
2.	Effect of Red Cell Storage on Microcirculation (N Oxide)	C
c.	Red Cell Metabolism and Preservation	
i.	Metabolism	
1.	Glucose	C
2.	Alternative Substrates	C
3.	Regulation of Energy Metabolism	C
4.	Synthetic Processes	C
5.	Membrane Metabolism	C
ii.	Red Cell Preservation in Transfusion Medicine	
1.	General Principles	C
2.	Collection and Separation Procedures	C
3.	Anticoagulant-Nutrient Solutions	C
4.	Additive Solutions	C
5.	Additional Factors Influencing RBC Quality	F
6.	Functionality	F
7.	Rejuvenation	F
8.	Frozen Storage	F
9.	Validation of RBC Storage Systems	F
d.	Red Cell Immunology and Compatibility Testing	
i.	Red Cell Immunology	
1.	Immune Response – Components and Characteristics	C
2.	Blood Group Antibodies	
a.	Physical Properties & Characteristics	C
3.	Red Cell Antigen-Antibody Interactions	C
a.	Direct Agglutination	C
b.	Hemolysis	C
c.	Antiglobulin test (DAT)	C
ii.	Compatibility Testing	
1.	Donor Testing	C
2.	Patient Testing	C
a.	Specimen Collection	C
b.	ABO Typing	C
c.	Rh Typing	C
d.	Tests for Unexpected Antibodies	C
e.	Reagent Red Cells for Antibody Detection	AR
f.	Automated Pre-Transfusion Testing	AR
g.	Additional Techniques	AR
h.	Molecular Techniques	F
3.	Principles of Antibody Identification	C
4.	Pre-Transfusion Testing	C
a.	Prior Records Check	C
b.	Selection of Blood for Transfusion	C

c.	Serologic Crossmatch	C
d.	Electronic Crossmatch	C
e.	Labeling	C
f.	Issue	C
g.	Emergency Release	C
h.	Bedside Check	C
i.	Hemovigilance	C
e.	Carbohydrate Blood Groups and Blood Group Systems	
i.	ABH Antigens	
1.	Biochemistry	C
2.	Antigenic Variants	C
3.	Secretion	AR
4.	Se and H genes	AR
5.	H-Deficient Phenotypes and Genotypes	AR
6.	Medical Implications of ABH and Secretor Systems	F
a.	ABO-Incompatible Solid Organ Transplantation	F
b.	ABO-Incompatible Hematopoietic Progenitor Cell Transplantation	F
ii.	Lewis System	AR
iii.	Ii System	AR
iv.	P System	AR
f.	Rh and LW Blood Group Systems	
i.	Rh Blood Group System – General Information & Nomenclature	C
ii.	Rh Genes and Their Expressed Proteins	AR
iii.	Molecular Basis for Rh Antigen Expression	AR
1.	D Antigen	AR
2.	C/c and E/e Antigens	AR
3.	RH Genotyping	AR
iv.	Rh-membrane Complex	AR
v.	Immune Response to Rh	AR
1.	Medical Aspects	AR
2.	Serologic Aspects	AR
3.	Molecular Aspects	AR
vi.	Rh Function	F
vii.	LW Blood Group System	F
1.	General Information	F
2.	Genes and Their Expressed Proteins	F
3.	Molecular Basis for Antigen Expression	F
4.	LW Function	F
g.	Other Protein Blood Group System	
i.	Kell and Kx Blood	
1.	Structure and Function of the Kell and XK Proteins	AR
2.	Kell-Transfusion Medicine Aspects	AR
a.	Transfusions	AR

b.	Hemolytic Disease of the Fetus and Newborn	AR
3.	Kell Variants	F
ii.	Duffy	
1.	Structure and Function of the Duffy Protein	AR
2.	Duffy-Transfusion Medicine Aspects	AR
a.	Transfusions	AR
b.	Hemolytic Disease of the Fetus and Newborn	AR
iii.	Kidd	
1.	Structure and Function of the Kidd Protein	AR
2.	Kidd-Transfusion Medicine Aspects	AR
a.	Transfusions	AR
b.	Hemolytic Disease of the Fetus and Newborn	AR
iv.	MNS	F
1.	Structure and Function of Glycoproteins A & B	F
2.	MNS – Transfusion Medicine Aspects	F
v.	Diego	F
vi.	Gerbich	F
vii.	Colton and GIL	F
viii.	Lutheran	F
ix.	Indian, Xg, and Scianna	F
x.	Chido/Rodgers	F
xi.	Knops	F
xii.	Cartwright, Dombrock, Cromer, and JMH	F
xiii.	OK and RAPH	F

4. Anemia and Red Blood Cell Transfusion

a.	Physiologic Adaptations to Blood Loss and Anemia	C
i.	Oxygen Transport to Blood Loss and Anemia	C
ii.	Adaptive Mechanisms in Anemia	C
iii.	Microcirculatory Effects of Anemia and Red Cell Transfusion	C
iv.	Pathophysiologic Processes and Anemia – Interactions	C
b.	Clinical Outcomes of Anemia and Red Cell Transfusion	C
i.	Risks of Anemia	C
ii.	Efficacy of Transfusion	C
1.	Adults	C
2.	Children	C
c.	Transfusion Guidelines	C
d.	Red Cell Transfusions – Decision Making	C
i.	The Bleeding Patient	C
ii.	The Surgical Patient	C
iii.	The Patient with Chronic Anemia	C
iv.	Transfusion Threshold	C
v.	Dose and Administration	C

5. Apheresis

- a. Apheresis: Principles and Technology of Hemapheresis
 - i. General Information and Principles C
 - ii. Current Devices and Technology AR
 - iii. Donor Apheresis AR
 - 1. Donor Care AR
 - 2. Specific Products and Procedures AR
 - 3. Adverse Effects on Donors and Recipients AR
 - iv. Therapeutic Apheresis AR
 - 1. Procedural and Technical Aspects AR
 - a. Substances Removed AR
 - b. Volume Removed AR
 - c. Replacement Fluids (Technical & Composition) AR
 - d. Schedule of Procedures (Timing, Number, & Location) AR
 - e. Vascular Access AR
 - f. Anticoagulant AR
 - g. Oversight AR
 - h. Adverse Effects AR
- b. Therapeutic Plasma Exchange
 - i. General Principles AR
 - 1. Mathematic Principles AR
 - 2. Regulation of IgG Metabolism AR
 - 3. Replacement Fluids (Clinical Aspects) AR
 - 4. Selective Extraction of Plasma Components AR
 - 5. Indication and Treatment Intensity Categories AR
 - ii. Neurologic Disorders
 - 1. Guillain-Barré Syndrome AR
 - 2. Chronic Inflammatory Demyelinating Polyneuropathy AR
 - 3. Peripheral Neuropathy and Monoclonal Gammopathy AR
 - 4. Myasthenia Gravis AR
 - 5. Lambert-Eaton Myasthenic Syndrome F
 - 6. Neuromyotonia and Limbic Encephalitis F
 - 7. Stiff-Person Syndrome F
 - 8. Paraneoplastic Neurologic Syndromes F
 - 9. Nonneoplastic Disorders of with CNS Antibodies F
 - 10. Multiple Sclerosis F
 - iii. Hematologic and Oncologic Disorders
 - 1. Thrombotic Thrombocytopenic Purpera C
 - 2. Monoclonal Proteins AR
 - 3. Blood Cell Alloantibodies F
 - 4. Hemolytic Uremic Syndrome F
 - 5. Posttransfusion Purpera F
 - 6. Idiopathic (Immune) Thrombocytopenic Purpera F

7.	Autoimmune Hemolytic Anemia	F
8.	Pure Red Cell Aplasia and Aplastic Anemia	F
9.	Coagulation Factor Inhibitors	F
iv.	Rheumatic and Other Immunologic Disorders	
1.	Goodpasture Syndrome	AR
2.	Cryoglobulinemia	F
3.	Rheumatoid Arthritis	F
4.	Systemic Lupus Erythematosus	F
5.	Rapidly Progressive Glomerulonephritis	F
6.	Solid Organ Transplantation	F
	a. Rejection	F
	b. Disease Recurrence	F
v.	Toxic and Metabolic Disorders	
1.	Hypercholesterolemia	F
2.	Refrsum Disease	F
3.	Drug Overdose and Poisoning	F
4.	Acute Liver Failure	F
c.	Specialized Therapeutic Hemapheresis and Phlebotomy	
i.	Therapeutic Phlebotomy	C
1.	Polycythemia Vera	C
2.	Secondary Erythrocytosis	C
3.	Hereditary Hemochromatosis	C
ii.	Red Cell Exchange	
1.	Principles and Techniques	AR
2.	Sickle Cell Disease	AR
3.	Acute and Emergent Complications	AR
	a. Indications and Management	AR
4.	Chronic Conditions or Preventive Strategies	AR
	a. Indications and Management	AR
5.	Malaria	F
6.	Babesiosis	F
iii.	Extracorporeal Photochemotherapy	
1.	Cutaneous T-cell Lymphoma	AR
2.	Graft-Versus-Host Disease	AR
3.	Techniques and Mechanisms	F
4.	Cardiac Allograft Rejection	F
iv.	Therapeutic Platelet Apheresis	F
1.	Primary Thrombocytosis	F
2.	Secondary Thrombocytosis	F
v.	Therapeutic White Cell Apheresis	F
1.	Hyperleukocytosis	F
2.	Inflammatory Bowel Disease	F
vi.	Selective Extraction of Low-Density Lipoproteins	F
1.	Principles, Indications, and Techniques	F

6. Hazards of Transfusion: Specific Adverse Events

- a. Hemolytic Transfusion Reactions C
 - i. Incidence C
 - ii. Signs and Symptoms C
 - iii. Complications C
 - iv. Causes C
 - v. Differential Diagnosis C
 - vi. Laboratory Investigation C
 - vii. Pathophysiology C
 - viii. Treatment C
 - ix. Prevention C
- b. Febrile, Allergic, and Non-Immune Transfusion Reactions
 - i. Febrile Non-Hemolytic C
 - 1. Description and Characteristics C
 - 2. Causes C
 - 3. Diagnosis C
 - 4. Treatment C
 - 5. Prevention C
 - ii. Allergic
 - 1. Description and Characteristics C
 - 2. Causes C
 - 3. Diagnosis C
 - 4. Treatment C
 - 5. Prevention C
 - iii. Transfusion-Associated Circulatory Overload C
 - 1. Description and Characteristics C
 - 2. Causes C
 - 3. Diagnosis C
 - 4. Treatment C
 - 5. Prevention C
 - iv. Anaphylactic and Anaphylactoid AR
 - 1. Description and Characteristics AR
 - 2. Causes AR
 - 3. Diagnosis AR
 - 4. Treatment AR
 - 5. Prevention AR
 - v. Massive and Rapid Transfusion – Complications AR
 - 1. Definitions and Description AR
 - 2. Citrate Toxicity AR
 - 3. Electrolyte and Acid/Base Disorders AR
 - 4. Hypothermia AR
 - 5. Microaggregate Reactions AR
 - vi. Special Transfusion Settings AR

1.	Granulocyte Transfusion	AR
2.	Autologous Transfusion	AR
vii.	Toxic Reactions from Blood Manufacture or Processing	F
1.	Hypotension	F
2.	Ocular	F
3.	Plasticizer Toxicity	F
4.	Dimethyl Sulfoxide Toxicity & Cryopreserved Progenitor Cells	F
c.	Transfusion-Associated Graft-Versus-Host Disease	AR
i.	Pathophysiology	AR
ii.	Incidence	AR
iii.	Risk Factors-General	AR
iv.	Fetuses and Neonates	AR
v.	Patient Populations at Risk	AR
1.	Congenital Immunodeficiency Syndromes	AR
2.	Malignancies	AR
3.	Hematopoietic Progenitor Cell Transplants	AR
4.	Solid Organ Transplants	AR
vi.	Immunocompetent Patients-Risk Factors	AR
vii.	Clinical Presentation and Diagnosis	AR
viii.	Treatment	AR
ix.	Prevention	AR
d.	Transfusion-Induced Iron Overload	AR
i.	Pathophysiology	AR
ii.	Iron Burden of Transfusions	AR
iii.	Clinical Features	AR
iv.	Measurement of Iron Burden	AR
v.	Management	AR
1.	Goals	AR
2.	Chelation Therapy	AR
e.	Transfusion-Related Acute Lung Injury	C
i.	Incidence and Epidemiology	C
ii.	Clinical Features	C
iii.	Pathophysiology	C
1.	Acute Lung Injury-Features	C
2.	Causes	C
3.	Mechanisms of Lung Damage	C
4.	Multiple Hit/Threshold Theory	C
iv.	Diagnosis and Differential Diagnosis	C
1.	Clinical, Physiologic, Radiologic, & Laboratory Features	C
2.	Consensus Definition	C
v.	Treatment and Management	C
vi.	Donor Investigation	C
vii.	Prevention	C
f.	Posttransfusion Purpura	AR

- i. Pathophysiology and Clinical Features AR
 - ii. Treatment AR
 - g. Transfusion-Associated Dyspnea C

7. Plasma Components and Derivatives

- a. Plasma Composition
 - i. General Features and Factors Influencing Plasma Composition C
 - ii. Albumin C
 - iii. Immunoglobulins C
 - iv. von Willebrand Factor Cleaving Protease AR
 - v. Coagulation Factors, Coagulation Factor Inhibitors, and von Willebrand Factor (e.g., description, half-life) AR
 - vi. Alpha-1-Antitrypsin F
 - vii. C1 Inhibitor F
- b. Preparation of Plasma Derivatives
 - i. Plasma Products – Indications and Clinical Use C
 - 1. Prothrombin Complex Concentrate (PCC) C
 - ii. Adverse Effects C
 - iii. Plasma Procurement AR
 - iv. Pathogen Inactivation/Removal AR
 - v. Plasma Manufacture F
 - vi. Industry Safety Programs F
 - vii. Recombinant DNA Technology and Manufacturing F
 - 1. Recombinant Factor VIIa F
- c. Plasma Transfusion and the Use of Albumin and Rh Immune Globulin
 - i. Fresh Frozen, Frozen, Cryo-Poor, Thawed & Stored Plasma C
 - 1. Manufacture and Features C
 - 2. Clinical Use, Indications, and Guidelines for Use C
 - a. Surgery C
 - b. Massive Transfusion, Trauma, and Disseminated Intravascular Coagulation C
 - c. Intensive Care C
 - d. Liver Disease C
 - e. Warfarin Reversal C
 - f. Therapeutic Apheresis C
 - 3. Dosing C
 - 4. Risks and Adverse Effects C
 - 5. Pathogen-Inactivated Plasma C
 - ii. Cryoprecipitate C
 - 1. Manufacture and Features C
 - 2. Clinical Use, Indications, and Guidelines for Use C
 - 3. Risks and Adverse Effects C
 - iii. Albumin AR
 - 1. Manufacture and Features AR

2. Clinical Use, Indications, and Guidelines for Use	AR
3. Risks and Adverse Effects	AR
iv. Rh Immune Globulin	AR
1. Manufacture and Features	AR
2. Clinical Use, Indications, and Guidelines for Use	AR
3. Risks and Adverse Effects	AR
v. IVIG	AR
1. Manufacture and Features	AR
2. Clinical Use, Indications, and Guidelines for Use	AR
3. Risks and Adverse Effects	AR
vi. Other Plasma Derivatives	
1. Fibrinogen Concentrates	AR
2. Alpha-1-Antitrypsin	F
3. C1 Inhibitor	F

8. Infectious Hazards of Transfusion

a. Transfusion-Transmitted Hepatitis	
i. Incidence	C
ii. Hepatitis B Virus	C
1. Epidemiology	C
2. Transmission	C
3. Clinical Features	C
a. Acute Infection	C
b. Chronic Infection	C
4. Serologic and Molecular Markers of Infection	C
5. Donor Testing and Counseling	C
6. Prevention	C
7. Treatment	C
iii. Hepatitis C Virus	C
1. Epidemiology	C
2. Transmission	C
3. Clinical Features	C
a. Acute Infection	C
b. Chronic Infection	C
4. Prevention	C
5. Treatment	C
iv. Hepatitis A Virus	F
1. Epidemiology	F
2. Transmission	F
3. Clinical Features	F
4. Donor Testing and Counseling	F
5. Prevention	F
6. Treatment	F

v. Hepatitis D	F
1. Epidemiology	F
2. Diagnosis	F
3. Transmission	F
4. Clinical Features	F
5. Prevention	F
vi. Hepatitis E Virus	F
1. Epidemiology	F
2. Diagnosis	F
3. Transmission	F
4. Clinical Features	F
5. Prevention	F
b. Retroviruses	
i. Overview	C
ii. Human Immunodeficiency Virus	C
1. General Information and Epidemiology	C
2. Incidence and Prevalence Among Blood Donors	C
3. Window Period and Risk of Transmission	C
4. Donor Testing and Counseling	C
5. Clinical Features	C
6. Prevention	C
7. Treatment	C
iii. Human T-cell Lymphotropic Viruses (HTLV I/II)	F
1. General Information and Epidemiology	F
2. Incidence and Prevalence Among Blood Donors	F
3. Window Period and Risk of Transmission	F
4. Donor Testing and Counseling	F
5. Clinical Features	F
6. Prevention	F
7. Treatment	F
c. Cytomegalovirus (CMV)	
1. General Information and Epidemiology	C
2. Incidence and Prevalence Among Blood Donors	C
3. Clinical Features	C
4. Prevention	C
5. Treatment	C
6. Window Period and Risk of Transmission	AR
7. Donor Testing and Counseling	AR
d. Other Viruses	
i. Other Herpesviruses	C
ii. West Nile Virus	AR
1. General Information and Epidemiology	AR
2. Transmission	AR
3. Donor Testing and Counseling	AR

4. Clinical Features	AR
5. Prevention	AR
iii. Parvovirus B19	F
1. General Information and Epidemiology	F
2. Transmission	F
3. Clinical Features	F
iv. Zika, Dengue, and Chikungunya	F
e. Transfusion Transmission of Parasites	
i. Chagas Disease	
1. General Information and Epidemiology	AR
2. Transmission	AR
3. Donor Testing and Counseling	AR
4. Clinical Features	F
5. Prevention	F
ii. Malaria	
1. General Information and Epidemiology	AR
2. Transmission	AR
3. Donor Testing and Counseling	AR
4. Clinical Features	F
5. Prevention	F
iii. Babesiosis	
1. General Information and Epidemiology	AR
2. Transmission	AR
3. Donor Testing and Counseling	AR
4. Clinical Features	F
5. Prevention	F
iv. Leishmaniasis	
1. General Information and Epidemiology	F
2. Transmission	F
3. Donor Testing and Counseling	F
4. Clinical Features	F
5. Prevention	F
f. Bacterial Contamination of Blood Products	AR
i. Red Blood Cells – Overview and Epidemiology	AR
ii. Allogeneic RBCs – Agents and Incidence	AR
iii. Autologous RBCs – Agents and Incidence	AR
iv. Plasma, Cryoprecipitate, and Derivatives – Agents and Incidence	AR
v. Platelets	AR
1. Sources of Contamination	AR
2. Agents and Incidence	AR
3. Clinical Features	AR
4. Treatment	AR
5. Prevention	AR
vi. Strategies to Reduce the Risk of Posttransfusion Sepsis	AR

1. Donor Screening	AR
2. Skin Preparation	AR
3. Diversion	AR
4. Apheresis versus Whole Blood-Derived Platelets	AR
5. Storage Time and Temperature	AR
6. Bacterial Detection	AR
7. Bacterial Elimination	AR
8. Syphilis	AR
g. Prion Diseases	F
i. General Information and Epidemiology	F
ii. Transmission	F
iii. Clinical Features	F
iv. Risk Management – Donor Selection	F
v. Blood Component Processing	F
vi. Plasma Derivative Manufacture	F
vii. Cellular, Tissue, and Organ Transplantation	F
h. Pathogen Inactivation	
i. Overview and Description	AR
ii. Plasma	
1. Psoralen Ultraviolet Light Treatment	C
2. Solvent/Detergent Treatment	AR
3. Methylene Blue Light Treatment	AR
4. Riboflavin Light Treatment	AR
iii. Platelets	
1. Psoralen Ultraviolet Light Treatment	C
2. Riboflavin Light Treatment	AR
3. Thionine Light Treatment	AR
iv. Red Cells	F
1. Alkylating Agents	F
2. Photosensitizers	F
3. Riboflavin Light Treatment	F
v. Emerging Technologies	F

9. Blood Donors and Blood Collection

a. Recruitment and Screening of Donors and the Collection, Processing and Testing of Blood	
i. Organization of Blood Services	
1. United States	C
2. Outside the United States	F
ii. Blood Donor Recruitment	AR
iii. Collection Process	
1. Donor Evaluation	AR
a. Consent	AR

b.	History & Physical Examination	AR
c.	Laboratory Testing	AR
d.	Deferral Criteria	AR
2.	Blood Collection	AR
a.	Whole Blood	AR
b.	Component Separation	AR
c.	Leukocyte Reduction	AR
d.	Automated Collection	AR
3.	Blood Component Testing	AR
a.	ABO/Rh	AR
b.	Antibody Screening	AR
c.	Infectious Disease	AR
4.	Distribution	AR
5.	Source Plasma	AR
iv.	Blood Donor Adverse Events	
1.	Donor Reactions	AR
a.	Categories	AR
b.	Incidence	AR
c.	Clinical Features	AR
d.	Risk Factors	AR
e.	Treatment	AR
f.	Prevention	AR
2.	Phlebotomy-Related	AR
a.	Categories	AR
b.	Incidence	AR
c.	Clinical Features	AR
d.	Risk Factors	AR
e.	Treatment	AR
f.	Prevention	AR
3.	Long-Term Effects of Donation	F
a.	Iron	F
b.	Platelets	F
c.	Plasma Proteins	F

10. Surgery Patients

a.	Alternatives to Transfusion: Perioperative Blood Management	AR
i.	Preoperative	AR
1.	Autologous Blood Donation	AR
2.	Anemia Optimization	AR
a.	Iron	AR
b.	Erythropoietin	AR
ii.	Intraoperative/Postoperative	AR
1.	Acute Normovolemic Hemodilution	AR

2.	Intraoperative Autologous Blood Recovery and Reinfusion (Cell Salvage)	AR
3.	Postoperative Autologous Blood Recovery and Reinfusion	AR
b.	Hemostasis for Surgery/Invasive Procedures	
i.	Preprocedure Blood Components	
1.	Common Laboratory Tests of Hemostasis and Their Relationship with Procedure-Related Bleeding	C
2.	Procedure-Related Bleeding	
a.	Central Venous Catheter	AR
b.	Liver Biopsy	AR
c.	Thoracentesis and Paracentesis	AR
d.	Gastrointestinal Endoscopy and Biopsy	AR
e.	Procedures on Upper Airway, Bronchoscopy, and Transbronchial Lung Biopsy	AR
f.	Renal Biopsy	AR
g.	Epidural Anesthesia, Lumbar Puncture, and Neurosurgical Procedures	AR
h.	Angiography	AR
ii.	Treatment of Bleeding	F
1.	Local	F
a.	Physical – Sutures, Electrocautery, Compression, Direct Packing, etc.	F
b.	Topical Agents	F
c.	Topical Sealants	F
d.	Topical Thrombin	F
e.	Topical Antifibrinolytics	F
2.	Generalized	F
a.	Skin and Membrane	F
b.	Purpura and Soft Tissue	F
c.	Small Vessel Bleeding During Surgery	F
d.	DDAVP	F
c.	Transfusion Therapy for Trauma and Burn Patients	
i.	Shock	
1.	General Information and Definition	C
2.	Hemorrhagic Shock and Classification	C
a.	Acidosis	C
b.	Hypothermia	C
c.	Coagulopathy	C
3.	Trauma Patient	
a.	Initial Resuscitation	
a.	Damage Control	C
b.	Blood Component Therapy	C
c.	Hemostatic Agents	AR
d.	Pharmacologic Agents	AR

b. Intraoperative	
a. Blood Component Therapy	C
b. Damage Control	AR
c. Temperature	AR
d. Autotransfusion	AR
e. Solid Organ Injury	AR
f. Hemostatic Agents	AR
g. Pharmacologic Agents	AR
c. Recovery Phase	C
a. Blood Component Therapy	C
d. Massive Transfusion	C
a. Definition	C
b. Blood Component Therapy	C
c. Complications	C
4. Patients with Thermal Injuries (Burns)	F
a. Initial Resuscitations	F
a. Fluid Therapy	F
1. Colloid	F
2. Crystalloid	F
b. Transfusion Therapy	F
c. Hemostatic Agents	F
d. Pharmacologic Agents	F
d. Transfusion Therapy in Solid Organ Transplantation	
i. Organ Procurement and Transplants	F
ii. Immunologic Barriers – ABO and HLA	AR
a. Across Immunologic Barriers	AR
b. Organ Selection	AR
c. Plasma Exchange	F
d. Pharmacologic Agents	F
iii. Immunohematology	AR
a. Patient Alloantibodies	AR
b. Passenger Lymphocyte Antibodies	AR
iv. Transfusion Therapy	AR
a. Liver	AR
b. Heart	AR
c. Lung	AR
d. Kidney	AR
e. Pancreas	AR
f. Other	AR
v. Special Needs	AR
a. CMV Low Risk	AR
b. Leukocyte Reduction	AR
c. Irradiation	AR

11. Biovigilance and Transfusion-Related Immunomodulation

- a. Biovigilance/Hemovigilance F
 - i. Requirements for Effective Program F
 - ii. Scope F
 - 1. Reporting Criteria F
 - a. Adverse Reactions F
 - b. Adverse Incidents F
 - c. Near Misses F
 - 2. Biovigilance F
 - a. Passive Reporting versus Active Surveillance F
 - b. Traceability F
 - 3. Blood Donors F
 - 4. Transfusion Recipients F

12. Platelets

- a. Platelet Production (Thrombopoiesis) C
 - i. Megakaryocyte Development, Maturation, and Differentiation C
 - ii. Thrombopoietic/Megakaryocyte/Hematopoietic Growth Factors C
 - iii. Genetic and Cellular Regulation of Thrombopoiesis C
 - iv. Platelet Production, Shedding, and Release C
- b. Platelets and Hemostasis C
 - i. Normal Platelet Plug and Clot Formation C
 - ii. Genetic/Congenital Platelet Disorders C
 - iii. Acquired Platelet Disorders C
- c. Platelet Transfusions
 - i. Collection and Storage of Platelet Preparations/Concentrates C
 - ii. Clinical Platelet Transfusions (Indications, Dose, and Schedule) C
 - iii. Alternatives to Platelet Transfusions (Thrombopoietic & Pharmacologic Agents) AR
- d. Platelet Immunity AR
 - i. Platelet Antigens (ABO, HLA, Platelet Specific) AR
 - ii. Disorders of Platelet Alloimmunization AR
 - iii. Platelet Autoimmunity AR
- e. Platelets in the Bloodstream AR
 - i. Platelet Circulation, Distribution, and Destruction AR
 - ii. Platelet Survival Kinetics in Health and Disease AR

13. Neutrophils

- a. Neutrophil/Granulocyte Transfusions – Primary Clinical Issues AR
 - i. Neutrophil Collection, Storage, and Transfusion AR
 - ii. Alternatives to Neutrophil Transfusions (Myelopoietic Factors) AR

14. Intravascular Cell Kinetics

- a. Concepts of Post-Transfusion Recovery and Tracking Labeled/Tracer Cells F

15. Obstetric and Pediatric Patients

- a. Hemolytic Disease of the Fetus and Newborn
 - i. ABO Incompatibility C
 - ii. Rh(D) and Other Fetal-Maternal RBC Incompatibilities C
 - iii. Management AR
 - 1. Diagnostic and Surveillance Tests AR
 - 2. Fetal and Neonatal Transfusions, Phototherapy, IVIG, etc AR
- b. Obstetric Transfusion Practices AR
 - i. Maternal Hematologic Disorders During Pregnancy AR
 - ii. Maternal Hemorrhagic and Transfusions During Pregnancy AR
 - iii. Fetal (Intrauterine) Transfusions AR
- c. Congenital Disorders of Clotting and Anticoagulant Protein
 - i. Developmental Physiology of Plasma Proteins C
 - ii. Hemophilia A, B, and von Willebrand Disease
 - 1. Pathophysiology and Treatment C
 - 2. DDAVP C
 - 3. Congenital Disorders of Non-Hemophilia Clotting Proteins F
 - 4. Congenital Disorders of Anticoagulant/Prothrombotic Proteins F
- d. Congenital Hemoglobinopathies and Hemolytic Anemias
 - i. Sickle Cell Disease (Pathophysiology and Treatment) C
 - ii. Non-Sickle Cell Hemoglobinopathies C
 - iii. Thalassemias (Pathophysiology and Treatment) C
 - iv. Congenital Red Cell Membrane and Enzyme Defects AR
- e. Neonatal Transfusions
 - i. Anemia of Prematurity (Pathophysiology and Treatment) C
 - ii. Thrombocytopenia of Prematurity (Pathophysiology and Treatment) C
 - iii. Neonatal Blood Banking Practices (Dedicated Units, WBC-Reduction, Irradiation, etc.) AR
 - iv. Neonatal/Infant Plasma, Cryoprecipitate, and Neutrophil Transfusions AR

16. Hematopoietic Progenitor Cell (HPC) Transplantation

- a. Biology of Marrow Transplantation
 - i. Autologous AR
 - ii. Allogeneic/Syngeneic AR
 - iii. Indications, Methods, Results, and Adverse Effects F
- b. Biology of HPC and HPC Transplantation
 - i. HLA Typing for HPC Transplantation AR
 - ii. HPC Biology F
 - iii. Identification and Measurement of HPC F
 - iv. Allogeneic/Syngeneic Donor Selection, Quantification, Eligibility F

v.	Processing Requirements for HPC	F
1.	General	F
2.	Patient-Specific	F
vi.	Regulatory, Compliance, and Accreditation	F
c.	HPC Sources and Collection	AR
i.	HPC Apheresis – Characteristics and Adverse Effects	AR
1.	Biology of Stem Cell Mobilization	AR
2.	Apheresis Consideration	
a.	Techniques, Vascular Access, Donor Management, and Adverse Events (Allogeneic vs. Autologous)	AR
3.	Mobilization Regimens	
a.	Indications, Dose, Schedule, Efficacy, and Adverse Effects	F
Chemotherapy		F
Growth Factors – G-CSF, GM-CSF		F
Adhesion Blockers-Plerixafor		F
b.	Scheduling Mobilization and Apheresis Collection	F
c.	Monitoring Mobilization and HPC Collection	F
d.	Collection of Lymphocytes for Infusion (Donor Lymphocyte Infusion [DLI])	F
4.	Scheduling Mobilization and Apheresis Collection	F
ii.	HPC-Marrow	F
1.	Methods of Harvesting	F
2.	Characteristics	F
3.	Adverse Effects	F
iii.	HPC Cord Blood	
1.	Characteristics and Methods	F
a.	Cord Blood Banking Donor Eligibility, Collection Methods, Processing, Testing, and Cryopreservation	F
b.	Cord Blood Characteristics	F
c.	Donor Selection for Transplant (Related and Unrelated)	F
iv.	Selection of Appropriate HPC Source for a Given Patient	F
d.	HPC Processing – Goals, Guidelines, and Methods (Preparation for Infusion)	F
i.	HPC for Autologous Transplants	F
ii.	HPC for Allogeneic Transplants	F
1.	Indications for Plasma, RBC Reduction	F
iii.	Preparation for Cells for Donor Lymphocyte Infusion	F
iv.	Cord Blood	F
v.	Processing of Other CT Products (e.g., Antigen-Directed T-cells, Marrow Stromal Cells)	F
e.	HPC Storage and Preservation	F
i.	Liquid Storage and Transport	

-Anticoagulant, Time, Temperature, Preservative, Cell Concentration	F
ii. Rationale for Cryopreservation	F
iii. Cryopreservation Theory and Practice	F
1. Cryoprotectants	F
2. Cryopreservation Techniques	
-Controlled Rate, "Dump Freeze"	F
3. Storage -Mechanical and Liquid Nitrogen (Vapor vs. Liquid)	F
f. Management of RBC Antigen Incompatibility in Allogeneic Transplantation	
i. Patient Transfusion Management	AR
1. Major or Minor ABO Incompatibility	AR
a. Immediate vs. Delayed Hemolysis	AR
2. Passenger Lymphocyte Syndrome (PLS)	AR
a. Cause, Diagnosis, Course, Therapy, Prevention	AR
ii. Graft Management	F
-Depletion of RBC (Major), Plasma (Minor)	F
g. HPC Assessment – Pre- and Post-Processing and Post Thaw	F
i. Cell Counts and Methods	F
ii. HPC Measurement and Enumeration	F
1. Flow Cytometry	F
2. Non-Flow Methods	F
iii. HPC Viability Assessment Techniques	F
iv. HPC Cell Culture Assays	F
v. HPC Functional and Differentiation Assays	F
vi. HPC Microbial Assessment	F
1. Gram Stain and Cultures	F
h. Cell Selection Methods and Applications	F
i. Positive and Negative Selection	F
1. Techniques, Results, Indications	F
ii. CD34 Cells and Others (e.g., Treg)	F
iii. Tumor Purging and T-cell Depletion	F
i. HPC and CTP Thawing and Post-Thaw Processing	
i. (Apheresis, Marrow, Cord Blood, etc.)	F
ii. Direct HPC Infusion vs. Pre-Infusion Cell Washing	F
iii. Special Considerations for Preparation of Cord Blood HPC for Infusion	F
j. HPC and CTP Infusion	F
i. General Guidelines	F
1. Filters, No Irradiation, Infusion Rate DMOS Limits, Infusion Pumps	F
ii. Adverse Effects and Infusion Reactions	
1. Incidence, Causes, Diagnosis, and Management	F
iii. Management and Infusion of Contaminated Products	F
k. Engraftment	
i. Definition, Chimerism, Relationship to CD34+ Cell Doses	F

- ii. Rates – Autologous vs. Allogeneic, Related vs. MUD, HPC Source, Conditioning F
 - iii. Engraftment Failure – Causes and Management F
 - iv. Immune Reconstitution Post-Transplant F
 - v. Donor Lymphocyte Infusion – Rationale, Efficacy F
 - I. HPC Laboratory Quality Assurance and Accreditation F
 - i. AABB, FACT, CAP, NMDP F
 - ii. Regulatory Considerations F
 - Federal GMP, GTP, State Supplies, Laboratory Development, Deviations, Non-Conforming HPC and CTP F
 - m. Laboratory Administration
 - i. Staff Hiring and Training F
 - ii. Facilities F
 - iii. Equipment and Supplies F
 - iv. Laboratory Development F
 - v. Deviations, Non-Conforming HPC and CTP F
 - n. Experimental Cell Therapies
 - i. Institutional vs. Commercially Sponsored F
 - ii. Types
 - (e.g., Marrow Stromal, Adoptive Therapy with T-cells, Genetically-Modified Cells) F
 - iii. Special Requirements for Processing (Clean Room, etc.) F
 - iv. Regulatory Considerations F

17. Blood Bank/Transfusion Medicine-Specific Administration and Laboratory Management

- a. Current Legal Issues
 - i. Blood Transfusion Injury Claims
 - 1. Informed Consent C
 - 2. Blood Shield Laws F
 - 3. Negligence F
 - 4. Standard of Care F
 - 5. Causation F
 - ii. HIPAA Privacy Rule C
 - iii. Donor Injury F
 - iv. Cord Blood F
 - v. Tissue Banking F
- b. Current Good Manufacturing Practice
 - i. General Overview C
 - ii. Licensing Products and Establishments AR
 - iii. Recalls and FDA Enforcement Activities AR
 - iv. Safety Initiatives AR
 - v. Enforcement Options AR
 - vi. Rationale AR
 - 1. Standard Operating Procedures AR

2.	Record Keeping	AR
3.	Personnel and Training	AR
4.	Calibration	AR
5.	Validation	AR
6.	Labeling	AR
7.	Error Management	AR
8.	Quality Control Unit and Internal Audits	AR
9.	Facilities and Equipment	AR
10.	Process and Production Controls	AR
vii.	Information Management	AR
viii.	Common Violations	AR
c.	Hospital Transfusion Services, Transfusion Committee, and Quality Assurance	
i.	Role of the Medical Director	AR
1.	Administrative	AR
2.	Clinical	AR
3.	Education	AR
ii.	Quality Assurance	AR
1.	Process Control	AR
2.	Error Management	AR
3.	Improving Transfusion Practice	AR
iii.	Regulatory and Accreditation Requirements	AR
1.	Food and Drug Administration	AR
2.	AABB	AR
3.	Joint Commission	AR
4.	College of American Pathologists	AR
iv.	Transfusion Committee	AR
1.	Membership	AR
2.	Functions	AR
3.	Oversight of Transfusion Policies, Procedures and Guidelines	AR
4.	Education	AR
v.	Other Administrative Issues	AR
d.	Transplant Organizations and Networks in the Regulation of Cellular and Tissue Therapy Programs	
i.	Hematopoietic Progenitor Cells	F
1.	Sources	F
2.	Indications	F
3.	HLA Matching	F
4.	Donor Registries and Networks, Outcomes Registries, Professional Associations and Networks	F
5.	Accreditation Organizations	F
ii.	Other Cellular Therapies	F
1.	Organizational Aspects	F
2.	Accreditation and Regulation	F
iii.	Tissue Banks	F

1. Organizational Aspects F
2. Accreditation and Regulation F