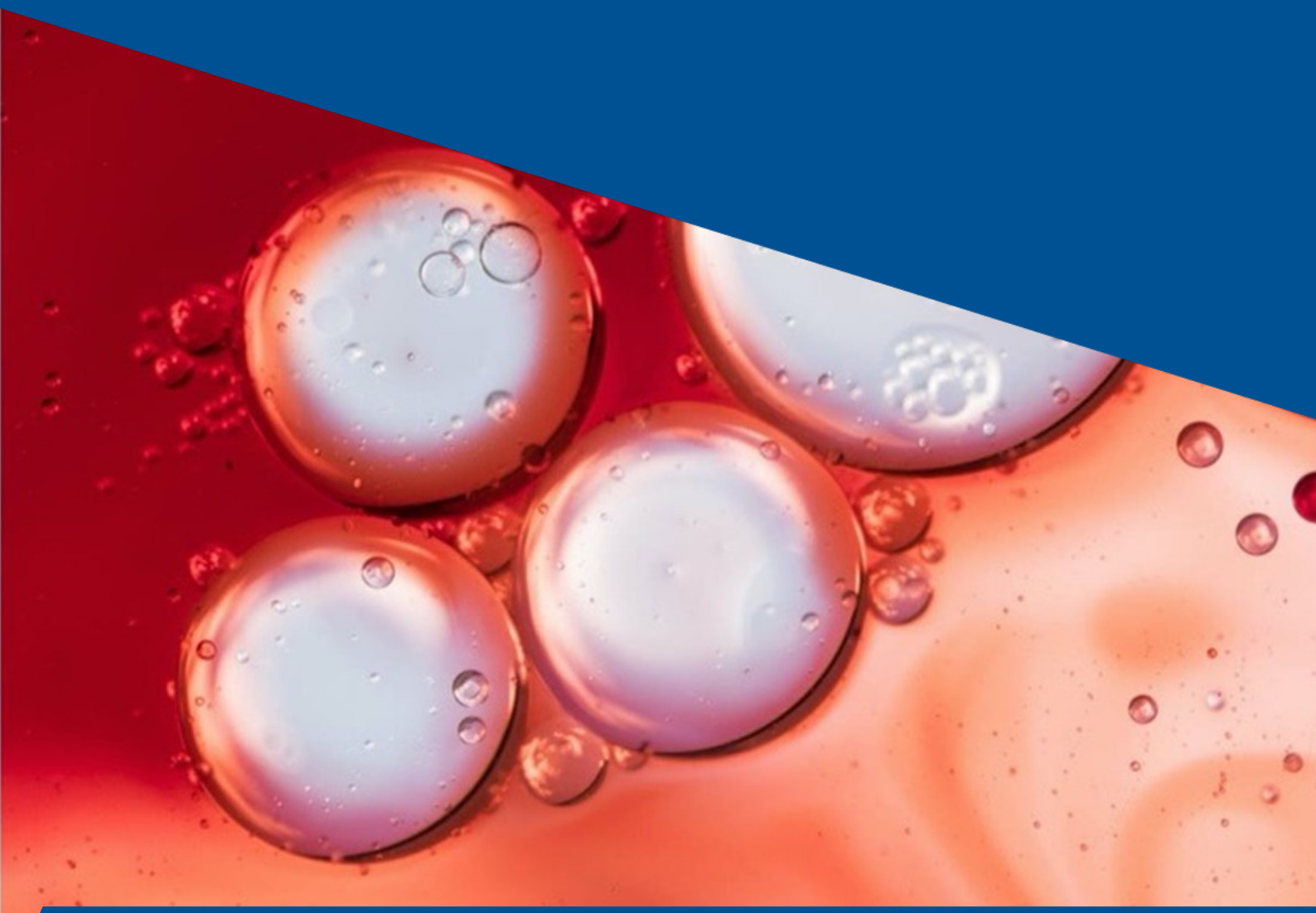
EUROPEAN HEMATOLOGY ASSOCIATION

EHA Curriculum Version 4

December 2022



Recommended length of training

Automatic recognition of professional qualifications across EU Member States, based on enhanced and harmonized minimum training requirements, is of crucial importance for the mobility of hematology professionals and, ultimately, for safeguarding the quality and safety of patient care. Given the wide scope of the discipline of hematology, as described in the Hematology Curriculum, EHA recommends a minimum training requirement for Hematology of five years, or three years when previous training encompassed the equivalent of at least two years in internal medicine.

Structure of the Curriculum

The Curriculum is composed of eight main sections divided into subsections fitting into one of these categories:

- Clinical skills
- Laboratory skills
- Competences related to regulations and principles

Each one of these sections is composed of topics in hematology that are assigned a recommended competence level according to endorsed European standards.

The eight main sections of the Curriculum are:

1. Clinical hematology: Benign disorders
2. Clinical hematology: Myeloid malignancies
3. Clinical hematology: Lymphoid malignancies and plasma cell disorders
4. Treatment of hematological disorders
5. Laboratory diagnoses
6. Thrombosis and hemostasis
7. Transfusion medicine
8. General skills

Levels descriptor

- LEVEL 1

I am confident I can:

Clinical skills (patient management and treatment)

- Describe the clinical features and epidemiology of a condition OR indications for aspecific treatment/procedure OR appropriateness/utility of a test
- Recognize a patient who may have this condition OR require this treatment OR benefitfrom this test

Laboratory skills

- Recognize the appropriateness and utility of a specific test for diagnosing and follow-upof specific hematological conditions

Competences related to regulations and principles

- Identify applicable regulations OR principles

- LEVEL 2

I am confident I can:

Clinical skills (patient management and treatment)

- Describe the pathogenesis
- Identify clinical features and investigations required to diagnose condition and interprettest results correctly
- Describe prognosis
- Identify correct referral routes OR initiate appropriate treatment (according toestablished protocol)
- Identify the need for and establish urgent consultation with subspecialist (particularly ifthe condition has potentially life-threatening debut symptoms)

Laboratory skills

- Choose/order appropriate test(s) for a specific patient, taking into account:
- indications
- accuracy and limitations
- what is entailed for the patient in performing the test
- Interpret results for a specific patient

Competences related to regulations and principles

- Apply this regulation/principle relevantly and appropriately within my own clinical work

- LEVEL 3

I am confident I can:

Clinical skills (patient management and treatment)

- Decide and manage first line treatment
- Identify treatment failure and need for second-line management
- Identify when there is a need for, and deliver, genetic counselling
- Seek out and integrate new knowledge and concepts in relation to condition/treatment

Laboratory skills

- Create/issue an interpretative report of test results
- Select/justify tests according to their cost-effectiveness

Competences related to regulations and principles

- Explain regulation/principle in appropriate language to a non-specialist audience (patientor student/trainee)
- Seek out and integrate new knowledge and concepts in relation to regulation/principle
- Recognize and plan how to improve own limitations, and demonstrate improvement

01

CLINICAL HEMATOLOGY: BENIGN DISORDERS

1A RED CELL AND IRON DISORDERS	Level
• Anemias due to deficiency (including iron, B12, folate)	3
• Anemia of chronic disease (including functional iron deficiency)	3
• Pure red cell aplasia	2
• Thalassemia	2
• Sickle cell disease	2
• Other hemoglobinopathies	2
• Red blood cell membrane disorders	2
• Red blood cell enzyme disorders	2
• Other congenital anemias (congenital dyserythropoietic anemia, sideroblastic anemia)	1
• Acquired immune hemolytic anemias	3
• Acquired non-immune hemolytic anemias	3
• Secondary erythrocytosis	3
• Familial erythrocytosis	2
• Iron overload (primary hemochromatosis and secondary iron overload)	3
• Porphyria and other rare metabolic disorders (e.g. methemoglobinemia)	1
• Iron deficiency without anemia	2
1B BONE MARROW FAILURE	
• Acquired aplastic anemia	3
• Paroxysmal nocturnal hemoglobinuria	3
• Fanconi's anemia	1
• Other inherited bone marrow failure syndromes (e.g. -Diamond - Blackfan, telomeropathies)	1
1C NON-MALIGNANT WHITE BLOOD CELL DISORDERS	
• Granulocyte dysfunction disorders	1
• Congenital neutropenia	1
• Acquired neutropenia	3
• Lymphocytopenia and immune deficiency syndromes	2
• Secondary leukocytosis	3
• Eosinophilia	3
1D QUANTITATIVE PLATELET DISORDERS AND ANGIOPATHIES (see also section 6)	
• Immune thrombocytopenia	3
• Thrombotic microangiopathies (e.g. thrombotic thrombocytopenic purpura)	3
• Heparin-induced thrombocytopenia	3
• Other drugs and vaccine-induced thrombocytopenia (see also section 6D)	3
• Secondary thrombocytosis	3
• Disorders with telangiectasia (e.g. Rendu-Osler-Weber disease)	2
1E CONSULTATIVE HEMATOLOGY	
• Hematological manifestations of non-hematological disorders	3
• Hematological manifestations of congenital metabolic disorders (e.g. Gaucher disease)	1
• Hematological variations and abnormalities in pregnancy	3
• Neonatal hematological variations and abnormalities	1
• Hematological manifestations in infectious diseases	3
• Hyposplenism and hypersplenism	3
• Hemophagocytic lymphohistiocytosis (HLH)	3

02

CLINICAL HEMATOLOGY: MYELOID MALIGNANCIES

2A MYELOPROLIFERATIVE NEOPLASMS	Level
• Chronic myeloid leukemia, *BCR::ABL1 -positive*	3
• Polycythemia vera	3
• Essential thrombocythemia	3
• Primary myelofibrosis (including early/prefibrotic myelofibrosis)	3
• Systemic mastocytosis	2
• Chronic eosinophilic leukemia, not otherwise specified	2
• Chronic neutrophilic leukemia	2
• Myeloproliferative neoplasm, unclassifiable	2
• Myeloid/lymphoid neoplasms with eosinophilia and tyrosine kinase gene fusions	2
2B MYELODYSPLASTIC/MYELOPROLIFERATIVE NEOPLASMS	
• Chronic myelomonocytic leukemia	3
• Other myelodysplastic/myeloproliferative neoplasms	2
2C MYELODYSPLASTIC SYNDROMES (MDS) AND PRE-MALIGNANT CLONAL CYTOPENIAS	
• MDS low risk	3
• MDS high risk	3
• Knowledge of MDS with significant genetic aberrations (e.g. germline predisposition, SF3B1, TP53, del[5q])	3
• Clonal cytopenia of undetermined significance	2
2D ACUTE MYELOID LEUKEMIA (AML)	
• Acute promyelocytic leukemia (APL)	3
• Other acute myeloid leukemias with recurrent genetic aberrations	3
• AML with myelodysplasia-related genetic mutations or cytogenetic abnormalities	3
• AML secondary to clinical MDS, myeloproliferative neoplasms (MPN), previous chemotherapy or radiotherapy	3
• AML with germline predisposition	2
• Acute leukemia of ambiguous lineage	2
• Blastic plasmacytoid dendritic cell neoplasm	2
• Myeloid sarcoma	2
• Other AML	3
2E PEDIATRIC MYELOID DISORDERS	
• Myeloid proliferations associated with Down syndrome	1
• Juvenile myelomonocytic leukemia (JMML) and JMML-like neoplasms	1
• Noonan syndrome-associated myeloproliferative disorder	1
• Childhood MDS	1

03

CLINICAL HEMATOLOGY:

LYMPHOID MALIGNANCIES AND PLASMA CELL DISORDERS

3A B-CELL NEOPLASMS AND OTHER B-CELL DISORDERS	Level
• B-lymphoblastic leukemias/lymphomas (including Ph+ acute lymphoblastic leukemia [ALL] and other genetic abnormalities)	3
• Aggressive B-cell lymphomas (including diffuse large B-cell lymphoma)	3
• Burkitt lymphoma	3
• Mantle cell lymphoma	3
• Follicular lymphoma	3
• Lymphoplasmacytic lymphoma/Waldenström macroglobulinemia	3
• Hairy cell leukemia	3
• Marginal zone lymphomas	3
• Monoclonal B-cell lymphocytosis (MBL)	3
• Chronic lymphocytic leukemia/small lymphocytic lymphoma (CLL/SLL)	3
3B T-CELL LYMPHOMAS AND NATURAL KILLER (NK)-CELL NEOPLASMS	
• T- lymphoblastic leukemia/lymphoma	2
• Mature T-cell lymphomas (e.g. peripheral T-cell lymphomas, anaplastic T-cell lymphomas, angioimmunoblastic lymphomas)	3
• Rare T- and NK-cell lymphomas	2
• Large granular T-cell leukemia	3
3C HODGKIN LYMPHOMA	
• Hodgkin lymphoma	3
3D SPECIAL ENTITIES	
• Immunodeficiency associated lymphoproliferative disorders (including post-transplant lymphoproliferative disorder (PTLD)	2
• HIV-associated lymphomas	2
• Cutaneous lymphoma (including mycosis fungoides and Sézary syndrome)	2
• Primary CNS lymphoma	2
• Histiocytic and dendritic cell neoplasms	2
• Castleman disease	2
3E PLASMA CELL NEOPLASMS	
• Monoclonal gammopathy of undetermined significance (MGUS)	3
• Solitary plasmacytoma	3
• Multiple myeloma	3
• Amyloid light-chain (AL) amyloidosis and monoclonal immunoglobulin deposition diseases	2
• Other plasma cell neoplasms (POEMS syndrome, plasma cell leukemia, monoclonal gammopathy of clinical significance, and others)	2
3F PEDIATRIC LYMPHOID MALINGNANCIES	
• Acute lymphoblastic leukemia (B or T)	1
• Pediatric lymphoma	1

04

TREATMENT OF HEMATOLOGICAL DISORDERS

4A PRINCIPLES of TREATMENT (mechanisms of action, pharmacology, refractoriness, and short- and long-term side effects)	Level
• Chemotherapy	3
• Radiotherapy	2
• Immunotherapy	3
• Targeted therapy	2
• Gene therapy	1
• Cellular therapy	2
• Treatment of hematological disorders in pregnancy	2
• Treatment of hematological disorders in frail patients	3
• Impact of treatment on normal physiology (growth, fertility, CNS)	2
• Treatment of thrombosis and bleeding	2
4B STEM CELL TRANSPLANTATION AND OTHER CELLULAR THERAPIES	
• Indication for autologous stem cell transplantation	3
• Indication for allogeneic stem cell transplantation	3
• Mobilization, collection, and manipulation of hematopoietic stem cells	2
• Criteria for selection of intensity for the preparative regimens	2
• Identification and selection of stem cell donor	2
• Acute and chronic graft-versus-host disease	2
• Acute and late complications, including long-term follow up (pulmonary complications, veno-occlusive disease of the liver, hemorrhagic cystitis, and other complications)	2
• Post-transplant monitoring	2
• Indications for CAR T-cell therapy	2
• Indications for specific and other gene-modified cell therapy	1
4C PREVENTION AND TREATMENT OF INFECTIOUS DISEASES	
• Neutropenic fever (including growth factors)	3
• Bacterial infection	3
• Fungal disease	3
• Viral infection (reactivation and primary infection)	3
4D SUPPORTIVE AND EMERGENCY CARE	
• Cytopenias, nausea, and pain management	3
• Hyperleukocytosis, hyperviscosity, coagulopathy, cytokine release syndrome and tumor lysis syndrome	3
• Rare complications (spinal cord compression and other neurological and psychiatric disturbances, superior vena cava syndrome)	2
• Nutrition	2
• Medical palliative care (see also section 8F)	2
• Psychological care (see also section 8E)	2
4E PHARMACOLOGY AND PHARMACOVIGILANCE	
• Pharmacovigilance	3
• Adverse event management	3
• Drug interactions	3

05

LABORATORY DIAGNOSIS

5A GOOD LABORATORY PRACTICE	Level
• Principles of laboratory management and organization	1
• Laboratory quality management and accreditation/certification (including internal and external quality control)	1
• Hazards and safety	2
• Reference ranges of laboratory values, with relevance to gender, age, and ethnicity	2
• Integrating diagnosis from laboratory investigations and relating them to the clinical picture	3
5B BLOOD COUNT AND MORPHOLOGY	
• Automated full blood count with white blood cell differential, and recognition of pseudo thrombocytopenia	2
• Performing aspiration and biopsy of bone marrow, and lumbar puncture	3
• Preparation, fixation, staining	2
• Evaluation and reporting of peripheral blood films, bone marrow aspirates, and trephine imprints	3
• Cytochemical; special stains of blood and bone marrow films in hematological conditions	2
• Review and interpretation of trephine, lymph node, and other relevant tissue biopsy specimens together with a pathologist	2
5C IMMUNOPHENOTYPING BY FLOW CYTOMETRY	
• Clinical applications of flow cytometry for diagnosis, classification, prognosis, and evaluation of measurable residual disease and stem cell quantification	3
• Pre-analytical and analytical phase of flow cytometry of blood, bone marrow, and body fluids (e.g. specimen processing, surface vs. intracytoplasmic staining, acquiring data, gating strategies)	1
• Essential surface and cytoplasmic markers, disease-oriented antibody panels applied in hematological conditions	3
• Data analysis	1
• Interpretation (e.g. determination of the lineage of cells of interest, clonality, stem cell quantification, telomere length, and specific subtypes of hematological condition)	2
5D GENETICS AND MOLECULAR BIOLOGY	
• Clinical applications of these techniques for diagnosis, classification, prognosis, and measurable residual disease evaluation of hematological disorders	3
• Conventional cytogenetic analysis, chromosome breakage, and fluorescence in situ hybridization	2
• Polymerase chain reactions for the detection of gene mutations, fusion genes, clonality assessment, and gene expression	2
• Other techniques for detection of copy number variations, gene polymorphisms, and recurrent mutations	1
• Interpretation of reports for detection and quantification of recurrent mutations (e.g.NGS, digital PCR)	2
• Other techniques for gene discovery and expression	1
5E COAGULATION	
• Techniques for assessing coagulation and platelets	2
• Assays for coagulation factors and inhibitors	1
• Assays for monitoring anticoagulants	2
5F IMMUNOHEMATOLOGY	
• Pretransfusion tests (including red blood cell typing and allocation, and influence of antibody treatment)	2
• Minor red cell, platelet, and neutrophil antigens	1
• Laboratory diagnosis of newborn hemolytic disease	1
• Laboratory diagnosis of alloimmune and autoimmune cytopenias	2
5G OTHER LABORATORY TECHNIQUES	
• Hemoglobin analyses (e.g. hemoglobin electrophoresis and high-performance liquid chromatography)	2
• Other red blood cell laboratory techniques (e.g. sickling test, oxygen affinity, red blood cell enzyme assays [pyruvate kinase], glucose-6-phosphate dehydrogenase)	2
• Laboratory work-up on iron metabolism and vitamin deficiencies	2
• Detection of immunoglobulin abnormalities	2

06

THROMBOSIS AND HEMOSTASIS

Mandy Lauw

Ingrid Pabinger

6A GENERAL ASPECTS	Level
• Assessment and management of patients with a bleeding tendency (including those with bleeding disorder of unknown cause)	3
• Management of acute bleeding (including adverse effects of pro-hemostatic drugs)	3
• Risk assessment, prevention, diagnosis, and treatment of venous thromboembolism	3
6B ACQUIRED BLEEDING DISORDERS	
• Massive bleeding in obstetrics, trauma, and surgery	2
• Disseminated intravascular coagulation (DIC)	3
• Coagulopathy associated with renal and liver disease	2
• Drug-induced bleeding (including anticoagulants and antithrombotic therapy)	3
• Acquired bleeding disorders (e.g. acquired hemophilia, acquired von Willebrand disease)	2
6C CONGENITAL BLEEDING DISORDERS	
• Hemophilia A and B	2
• Von Willebrand disease	2
• Other (rare) congenital clotting factor disorders	2
• Considerations in carriers of hemophilia in relation to pregnancy	2
• Congenital platelet disorders	2
6D THROMBOTIC DISORDERS	
• Anticoagulant and thrombolytic therapy in non-hematological medical conditions (including arterial thrombosis)	2
• Thrombophilia (congenital and acquired)	2
• Prevention and management of venous thromboembolism in pregnancy	2
• Thrombosis in children, including purpura fulminans	1
• Prevention and management of venous thromboembolism in cancer	3
• Unusual site venous thromboembolism (e.g. splanchnic vein, cerebral vein)	2
• Heparin-induced thrombocytopenia (and thrombosis) (see also section 1D)	3
• Vaccine-induced thrombocytopenia (and thrombosis) (see also section 1D)	2

07

TRANSFUSION MEDICINE

7A BLOOD DONATION	Level
• Selection of blood and apheresis donors and deferral time between donations (for monitoring iron status)	2
• Epidemiology and screening for blood-borne infections	2
• Blood collection procedures	2
• Detection and management of adverse events related to blood donation	2
7B CLINICAL USE OF BLOOD COMPONENTS	
• Indication, choice and application of blood components. Items included: transfusion in elderly patients, autoimmune hemolytic anemia (AIHA), massive blood loss	3
• Use of blood products and alternatives in fetal, neonatal, and pediatric patients	1
• Blood alternatives; management of patients who refuse blood transfusion	2
• Transfusion reactions and complications, including hemovigilance	3
• Patient blood management (multidisciplinary approach to optimize blood transfusion)	2
• Management of platelet transfusion refractory patients	3
7C APHERESIS	
• Indications and complications	2

08

GENERAL SKILLS

8A BASIC BIOLOGICAL CONCEPTS	Level
• Hematopoiesis and stem cell biology	2
• Chromosome and gene structure	2
• The role of deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and proteins in normal cellular processes	2
• Transcription and translation, epigenetic regulation, RNA splicing, signal transduction, cell cycle regulation and apoptosis, and methods of investigation	2
• Epigenetic inheritance and pharmacogenomics in hemato-oncology	2
• Mechanisms in hemostasis	2
• Clonal hematopoiesis	2
• Immune biology	2
8B EVIDENCE-BASED MEDICINE	
• Fundamental principles of evidence-based medicine	2
• Critical appraisal of scientific literature, including statistical methods	2
• Strategic and economic implications of combining drugs and clinical biomarkers	2
8C GOOD MEDICAL PRACTICE AND CLINICAL TRIALS	
• Multidisciplinary decision-making	3
• Clinical trial-related international and local guidelines and legislation (Good Clinical Practice)	2
• Obtaining informed consent in clinical trials and in routine daily medical practice	3
• Methods for assessing patient reported outcomes, including quality of life	3
• The impact of age on patient management (children, adolescents, and young adults) (geriatric/co-morbidity/frailty assessment) (see also section 4)	3
• Indications for genetic counseling	2
8D ETHICS AND LAW	
• Basic principles of medical ethics (including Declaration of Helsinki)	3
• Functions of the Ethics Committee	2
• National regulations on how to manage a patient with reduced autonomy	2
• Regulations concerning the use of human cells and tissues (bio-banking)	2
• Basic principles of health economics and cost-effectiveness, including ethical implications of national health system	2
• European and national directives on patient rights	2
• Definition and disclosure of conflict of interest	3
• Regulations on off-label use of drugs	2
8E COMMUNICATION SKILLS AND PSYCHOSOCIAL ISSUES	
• Communication with patients (principles, methods, and techniques)	3
• Communication with patients' relatives and cohabitants	3
• Communication within a multi-disciplinary team	3
• Psychosocial assessment	2
• Taking a history and physical examination directed at hematological diseases	3
8F PALLIATIVE CARE AND END-OF-LIFE TREATMENT (see also section 4D)	
• Palliative care decisions and management of patient communication at breakpoint decisions	3
• Management and decision-making related to end-of-life situations, including non-resuscitation and the requirement of patient information and participation in decision-making	3
• National legal requirements regarding euthanasia	3

APPENDICES

APPENDIX I.

EHA Curriculum Committee:

• Tomas	Navarro Ferrando (Chair)	Spain
• Marielle	Wondergem (Vice-Chair)	Netherlands
• Gunnar	Birgegård	Sweden
• Antonio	Almeida	Portugal
• Mahesh	Prahladan	United Kingdom
• Carlos	Fernández de Larrea	Spain
• Alicia	Rovó	Switzerland
• Janaki	Brolin	United Kingdom

APPENDIX II.

Curriculum Update Working Group:

• Antonio	Almeida	Portugal
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• Janaki	Brolin	Sweden
• Carlos	Fernández de Larrea	Spain
• Joan	Ramon Grifols	Spain
• Kai	Hubel	Germany
• Mandy	Lauw	Netherlands
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• Gert	Ossenkoppele	Netherlands
• Ingrid	Pabinger	Austria
• Anna	Porwit	Sweden
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