

Table 8.1. Epidemiology of Leukemia in the United States (2010)

Type of Leukemia	Annual Incidence (Number of New Cases)	Percentage of All Leukemias (%)	Annual Deaths	Mean Age
Acute lymphocytic leukemia	5,330	12	1,420	2–5 years
Chronic lymphocytic leukemia	14,990	35	4,390	>60 years
Acute myeloid leukemia	12,330	29	8,950	63 years; most after age 40
Chronic myeloid leukemia	4,870	11	440	60 years ^a
Other leukemia	5,530	13	6,640	
Total	43,050	100	21,840	

^a Prognosis is less favorable when it occurs at younger ages.
Adapted from The Leukemia and Lymphoma Society Facts 2010–2011.

Table 8.2. Medical Considerations for Patients with Leukemia

	Medical History	Physical Examination	Laboratory Testing	Medical Treatment
Acute lymphocytic leukemia	<i>Sudden onset</i> Chills of unknown origin, easy bleeding, fatigue, recurring infections, anemia	Fever, pallor, lymphadenopathy, hepatomegaly, splenomegaly	CBC: $\geq 20\%$ lymphoblasts in peripheral blood smear, thrombocytopenia Immunotyping ^a : Detection of nuclear enzyme Tdt, CD10, CD19, CD22	Chemotherapy agents include alkylating agents, antimetabolites, enzymes, mitosis inhibitors, and supportive medication including antibiotics and steroids HSCT
Chronic lymphocytic leukemia	<i>Slow onset</i> Fatigue, anorexia, unexplained weight loss, night sweats, recurring infections, delayed healing, bleeding tendency	Fever, lymphadenopathy	CBC: Presence of >5000 mature lymphocytes/mL in peripheral blood Immunotyping may detect CD3, CD5, CD19, CD20, or CD 23 marker positive B lymphocytes	Cyclophosphamide, vincristine, doxorubicin, and prednisone Specific monoclonal antibodies such as rituximab, alemtuzumab, and ofatumumab
Acute myeloid leukemia	<i>Sudden onset</i> Rigors, easy bleeding, fatigue, anorexia and weight loss, recurring infections, sternal pain	Fever, pallor, hepatomegaly, splenomegaly, lymphadenopathy	CBC: At least 20% immature myeloblasts Immunotyping: Myeloblasts positive for CD13, CD33, CD34, CD65, and CD117 markers Bone marrow biopsy: presence of myeloblasts	Alkylating agents such as busulfan, cisplatin, carboplatin, daunorubicin, cyclophosphamide, and chlorambucil HSCT
Chronic myeloid leukemia	<i>Slow onset until disease progresses to blast stage</i> Fatigue, weakness, weight loss, infections, spontaneous bleeding	Fever, hepatomegaly, splenomegaly, lymphadenopathy	CBC: Total leukocytes $>50,000$ /mL Cytogenetics ^b : Presence of Philadelphia chromosome in 90% patients Bone marrow biopsy—presence of immature blasts	Imatinib mesylate (Gleevec®) is effective against CML with the BCR-ABL gene mutation HSCT

^a Immunotyping refers to the laboratory technique involved in the detection of cell surface proteins with specific immunological characteristics.

^b Cytogenetics refers to a very specific branch of molecular genetics involved in the study of structure and function of chromosomes. CBC, complete blood count; HSCT, hematopoietic stem cell transplant.

Table 8.3. Medical Considerations for Patients with Anemias

	Medical History	Physical Examination	Laboratory Testing	Medical Treatment
Iron deficiency anemia	Fatigue, dyspnea, stomatodynia	Pallor on skin and oral mucosa Depapillated atrophic tongue Koilonychia (spoon-shaped nails) Blue sclera Failure to thrive in children	CBC: Lowered hemoglobin count Blood smear: Microcytic hypochromic red blood cells	Address underlying cause if applicable; oral ferrous sulfate 200 mg TID Parenteral iron therapy Vitamin C supplements may aid iron absorption
G6PD-deficiency anemia	Oxidative crisis: Dyspnea, fatigue	Jaundiced skin Yellow sclera Pallor/icterus on oral mucosa Splenomegaly	G6PD screening Indirect bilirubin levels elevated	Prescreening and avoidance of oxidative medication and other triggers
Sickle cell anemia	Sickle cell crisis: Chest, abdominal and bone pain, nausea, vomiting, infections	Pallor/jaundice Frequent skin ulcers Infants: Swelling associated with small joints of hands and feet Dental hypoplasia/delayed eruption Step-ladder appearance of alveolar bone on dental X-rays	Sickledex test, in high-risk populations Hemoglobin electrophoresis Indirect bilirubin levels for hemolysis evaluation	Treatment is palliative (intravenous fluid, oxygen therapy, narcotic pain control, antibiotics as needed) Hydroxyurea increases hemoglobin F ^o and reduces crisis rate and hospitalizations Blood transfusions in case of sickle cell crisis Allogeneic HSCT is an option in severe recalcitrant cases

(Continued)

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	Medical History	Physical Examination	Laboratory Testing	Medical Treatment
Thalassemia (major and minor)	<p>Minor: May be asymptomatic</p> <p>Major: Symptoms from mild to severe</p>	<p>Major: Diagnosed within a year by severe jaundice, pallor, growth retardation, splenomegaly</p> <p>Minor: "Chipmunk facies"</p> <p>Bimaxillary protrusion with spacing of teeth</p> <p>Cranial nerve palsies</p> <p>Thin cortical plates and spongy marrow</p>	<p>Peripheral smear shows hypochromic, microcytic red blood cells</p> <p>Hemoglobin electrophoresis shows elevated levels of hemoglobin F^a</p> <p>DNA analysis of prenatal fluid shows presence of disease</p>	<p>Major: Transfusions to maintain Hgb levels at least 10mg/dL are crucial for survival</p> <p>Minor: No intervention necessary; genetic counseling advised</p>
Vitamin B ₁₂ -and folate-deficiency anemia	<p>Weakness, irritability, fatigue, sensory deficit: Ataxia and tingling/numbness in extremities, oral burning</p>	<p>Failure to thrive in children</p> <p>Pernicious anemia: Premature graying hair, vitiligo and blue eyes, atrophic glossitis, glossodynia, angular cheilitis</p>	<p>CBC, vitamin B₁₂ levels, folate levels</p> <p>Schilling's test^b</p>	<p>Vitamin B₁₂ supplements are effective in B₁₂-deficient anemia and pernicious anemia</p> <p>Folate-deficient anemia is treated with replacement therapy</p>
Aplastic anemia	<p>History of recurring severe infections, fatigue, weakness</p>	<p>Severe jaundice or pallor</p> <p>Developmental retardation in Fanconi's anemia; gingival hyperplasia and spontaneous oral bleeding</p> <p>Oral mucosal pallor and petechiae</p>	<p>Bone marrow biopsy</p> <p>Erythropoietin levels</p>	<p>Immunosuppressive therapy</p> <p>Epoetin alfa^c</p> <p>HSCT</p> <p>Management of infections and other symptoms</p>

^a Fetal hemoglobin whose production is otherwise normally curbed at birth.

^b Schilling's test: A specific test for pernicious anemia that involves ingestion of radiolabeled vitamin B₁₂ by the subject and detection of excreted levels of vitamin B₁₂ in urine.

^c Epoetin alfa is recombinant human erythropoietin and can induce erythrocyte production in the bone marrow.

References: (1) Little et al.¹¹; (2) Mawardi et al.¹²; (3) Lanzkron et al.¹³.

CBC, complete blood count; HSCT, hematopoietic stem cell transplant; TID, three times a day.

Table 8.4. Medical Considerations for Patients with Lymphomas

	History	Clinical Examination	Diagnosis	Medical Management
Hodgkin's lymphoma	Fever, night sweats, weight loss, fatigue Respiratory distress, dysphagia, and pain are possible	Enlarged lymph nodes: Mediastinal, cervical, axillary, or inguinal Pruritis	Lymph node biopsy or bone marrow aspirate: Presence of distinct Reed–Sternberg giant cells	Combination of chemotherapy and radiation to affected nodes Untreated disease results in death from bone marrow failure or infection
Non-Hodgkin's lymphoma	Fever, weight loss, fatigue, chest discomfort, night sweats, malaise, visceral pain, persistent cough, spontaneous bleeding, recurrent infections	Mediastinal lymphadenopathy, pleural effusion, hepatomegaly, splenomegaly	CBC: Anemia, thrombocytopenia, leukopenia Lymph node biopsy or aspirate for histopathology Chest X-rays CT scan if suspected bony involvement	Less aggressive early-stage disease may be treated with radiation alone Diffuse large B-cell lymphoma is treated with combination chemotherapy Radiotherapy may be an adjunct Specific monoclonal antibodies targeting antigens found on malignant lymphocytes HSCT

References: (1) Little et al.²; (2) Mawardi et al.¹¹
CBC, complete blood count; HSCT, hematopoietic stem cell transplant.

Table 8.5. Normal Complete Blood Cell (CBC) Count and Differential White Blood Cell (WBC) Count^a and Disease-Related Changes

Blood Cell Type	Normal Reference Range	May be Increased in:	May be Decreased in:
Red blood cells ^b (RBCs)	M: 4.3–5.7 million cells/ μ L F: 3.8–5.1 million cells/ μ L	Polycythemia, congenital heart disease, pulmonary disease, smoking, dehydration, renal disease with high erythropoietin production	Anemias, hemorrhage, bone marrow failure, erythropoietin deficiency due to renal disease, hemolysis, acute leukemia, malnutrition, multiple myeloma
Hemoglobin ^b (Hgb)	M: 13.5–17.5g/dL F: 12.0–16.0g/dL	See RBC	See RBC
Hematocrit ^b (HCT)	M: 39–49% F: 35–45%	See RBC	See RBC
Platelets	150,000–400,000/ mm^3	Polycythemia, leukemia, severe hemorrhage	Thrombocytopenia purpura, aplastic anemia, acute leukemia, acute disseminated intravascular coagulation
White blood cells (WBCs) ^c	4,500–11,000 cells/ μ L	Leukemia, infections, inflammation, severe burns, severe emotional or physical stress (see below differential)	Autoimmune/collagen vascular disease, 25% with acute leukemia, bone marrow failure, disease of liver or spleen (see below differential)

Differential WBC

Neutrophils segmented (PMNs)	54–62%	3,000–5,800/ mm ³	Acute bacterial infection, inflammatory disease, CML, bone marrow disorders, hemorrhage, diabetic acidosis, glucocorticoid use	Chemotherapy, aplastic anemia, leukemias, radiation therapy, widespread bacterial or viral infection
Neutrophils bands	3–5%	150–400/mm ³	Acute bacterial infection, acute leukemia, myeloproliferative diseases	CLL
Lymphocytes	23–33%	1,200–3,000/ mm ³	CLL, viral infections, radiation therapy, multiple myeloma	HIV infection, lupus, acute leukemia, CML, sepsis, radiation exposure
Monocytes	3–7%	285–500/mm ³	Viral or parasitic infection, inflammatory disorders, tuberculosis, monocytic leukemia, Hodgkin's disease, lipid storage disease	Leukemia, bone marrow failure
Eosinophils	1–3%	50–250/mm ³	Allergic disorders, CML, parasitic disease, inflammatory disorders, infections, bone marrow disorders, pernicious anemia, collagen vascular disease	
Basophils	0–0.75%	15–50/mm ³	CML, chronic inflammation, hypersensitivity reaction to foods, radiation therapy	Acute allergic reaction

^a Normal ranges vary with each laboratory.

^b Varies with altitude.

^c WBC normal range for infants (8,000–15,000/mm³) and children age 4–7 years (6,000–15,000/mm³).

F, female; M, male; absolute neutrophil count (ANC) = WBC × (%PMNs + % Bands).

References: (1) American Academy of Pediatric Dentistry⁵; (2) Elin⁶.

PMN, polymorphonuclear leukocytes.