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UNDERSTANDING BLOOD CANCER



Blood, Bone Marrow and the Lymphatic System. Blood is the main transport system in the body. It is the liquid that flows through a person's arteries and veins. It carries oxygen and nutrients to the lungs and tissue. It carries away waste products by taking them to the kidneys and liver, which clean the blood.

Blood Cells. Blood has four main components.

- **Red Blood Cells.** Red blood cells contain a protein called "hemoglobin" which carries oxygen to all the cells in the body and helps remove carbon dioxide from the body.
- **Platelets.** Platelets help stop bleeding at the site of an injury.
- **White Blood Cells.** White blood cells help fight infection and disease. There are several types of white blood cells including neutrophils, monocytes, eosinophils, basophils and lymphocytes.
- **Plasma.** The liquid part of blood, called "plasma," is largely water but also includes proteins, hormones, vitamins, minerals, electrolytes and antibodies.

The healthcare team will monitor your child's blood cell counts closely, both during and after treatment. See **Blood Cell Counts** on page 3 to learn more.

Bone Marrow. Bone marrow is the spongy tissue inside bones. Stem cells in the bone marrow develop into blood cells. The process of blood cell formation is called "hematopoiesis." Healthy individuals have enough stem cells to keep producing new blood cells continuously. Blood passes through the bone marrow and picks up fully developed and functional red blood cells, white blood cells and platelets to circulate throughout the body.



Visit www.LLS.org/3D to view an interactive 3D image of blood cell development.

The Lymphatic System. The lymphatic system is part of the immune system, which helps protect against disease and infection. It includes

- Lymph nodes (small, oval-shaped organs located throughout the body that help trap and kill disease and infection)
- Lymphatic vessels (thin tubes similar to blood vessels that carry lymph)
- The spleen (the organ that filters blood)
- The thymus gland (the organ that produces lymphocytes until young adulthood)

Lymph (clear fluid) and lymphocytes (type of white blood cells) travel through the lymph vessels into the lymph nodes where the lymphocytes destroy infection and disease that invade the body. There are three main types of lymphocytes:

- B lymphocytes (B cells)
- T lymphocytes (T cells)
- Natural killer (NK) cells

Lymphocytes are also found in other parts of the body including the skin, spleen, tonsils and adenoids, intestinal lining and the thymus.

Types of Blood Cancer. Leukemia, lymphoma, myeloma, myelodysplastic syndromes (MDSs) and myeloproliferative neoplasms (MPNs) are types of cancer that can affect the bone marrow, blood cells, lymph nodes and other parts of the lymphatic system. Each of these blood cancers also contains different subtypes. Blood cancers can be acute (severe and sudden onset) or chronic (the disease progresses slowly). Blood cancers affect people of all ages, races and genders. However, some types of blood cancers are more common in children.

Leukemia. Leukemia begins in a cell in the bone marrow. The cell undergoes a change and becomes a type of leukemia cell. The leukemia cells may grow and survive better than normal cells. Over time, the leukemia cells crowd out and/or suppress the development of normal cells. The rate at which leukemia progresses and the ways in which the cells replace the normal blood and bone marrow cells are different with each type of leukemia.

Leukemia is the most common type of cancer in children, adolescents and young adults younger than 20 years, accounting for 24.7% of cancer cases in this age-group.

Subtypes of leukemia include

- Acute lymphoblastic leukemia (ALL)
- Acute myeloid leukemia (AML)
- Chronic lymphocytic leukemia (CLL)
- Chronic myeloid leukemia (CML)
- Juvenile myelomonocytic leukemia (JMML)

Acute lymphoblastic leukemia accounts for about 3 out of 4 cases of childhood leukemia. Acute myeloid leukemia accounts for most of the remaining cases of childhood leukemia. Chronic leukemia in children is rare. Juvenile myelomonocytic leukemia is an uncommon blood cancer that is most often diagnosed in infants and young children.

Typically, acute leukemia needs to be treated right away with chemotherapy. Your child may be hospitalized for treatment soon after diagnosis.

Lymphoma. “Lymphoma” is the name of a group of blood cancers that develop in the lymphatic system. Lymphoma is the third most common cancer in children, adolescents and young adults younger than 20 years, accounting for 14% of cancer cases in this age-group. The two main types are Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL).

- Hodgkin lymphoma (HL) is distinguished from other types of lymphoma by the presence of Reed-Sternberg cells. These are large, cancerous cells, named for the scientists who first identified them. With proper treatment, HL can be cured in most patients. Hodgkin lymphoma is more common in adolescents 15 years and older and young adults than it is in younger children.
- Non-Hodgkin lymphoma (NHL) comprises a diverse group of diseases distinguished by the characteristics of the cancer cells associated with each disease type. The most common NHL subtypes in children include
 - Burkitt lymphoma
 - Lymphoblastic lymphoma
 - Diffuse large B-cell lymphoma (DLBCL)
 - Anaplastic large cell lymphoma (ALCL)

It is important to know your child’s exact NHL subtype because different types of NHL require different treatment.

Myelodysplastic Syndromes (MDSs). Myelodysplastic syndromes comprise a group of diseases of the blood and bone marrow, with varying degrees of severity, treatment needs and life expectancy. An MDS may be primary (de novo) or treatment-related. MDS is not commonly diagnosed in children, adolescents and young adults younger than 20 years.

Other Types of Blood Cancer. Myeloma and myeloproliferative neoplasms (MPNs) are not commonly diagnosed in children, adolescents and young adults younger than 20 years.



For more information about blood cancers, call **(800) 955-4572** or visit www.LLS.org/InformationSpecialist to contact an LLS Information Specialist who can provide you with accurate, up-to-date disease, treatment and support information.



You can also visit www.LLS.org/DiseaseInformation or www.LLS.org/webcast to find more disease-specific information.

For more information about these diseases, visit www.LLS.org/booklets to view disease booklets for specific blood cancer diagnoses.

For more information about lab and imaging tests, visit www.LLS.org/booklets to view *Understanding Lab and Imaging Tests* or visit www.LLS.org/videos to watch the *Lab and Imaging Tests* series.

Blood Cell Counts. The healthcare team will order frequent blood tests to monitor your child's blood cell counts, both during and after treatment. Blood cancers and treatment for blood cancers affect blood cell counts in a number of different ways. Children receiving treatment for blood cancer can develop

- Anemia (a low number of red blood cells)
 - Red blood cells contain hemoglobin which carry oxygen around the body. Patients with severe anemia can be pale, weak, tired and become short of breath.
- Thrombocytopenia (a low number of platelets)
 - Patients with thrombocytopenia are at risk for excessive bruising and bleeding. Bleeding can occur from a wound or it can be internal. Ask the healthcare team what precautions you should take if your child has a low platelet count.
- Neutropenia (a low number of neutrophils, a type of white blood cell)
 - Patients with neutropenia are at an increased risk of infection.
- Pancytopenia (a low number of all of these three blood components)

Treating Low Blood Cell Counts. Very low blood cell counts can lead to serious complications that can cause delays in treatment. Treatments to improve blood cell counts include

- Blood transfusions
- Medications called “growth factors” to stimulate the bone marrow to produce more blood cells.



For more information about blood cell counts, visit www.LLS.org/booklets to view *Side-Effect Management: Managing Low Blood Cell Counts*.

Monitoring Blood Cell Counts and Lab Values. Talk with the healthcare team about your child's blood cell counts, especially if the values change. Ask for an explanation and if there is anything that can be done to help blood cell counts return to a healthy range. Ask if your child needs to take any special precautions to avoid complications. Ask members of the healthcare team for printed copies of all lab reports and keep them with your child's medical records.

If the hospital or treatment center provides a web-based “patient portal” to access medical records, ask the healthcare team how to access and navigate the patient portal to view lab reports.

LAB REPORT TERMINOLOGY

These definitions of lab terms will help you understand the information on the lab report. Ask your child’s healthcare team to explain how changes in these readings affect your child’s health.

Absolute Neutrophil Count (ANC)	The number of neutrophils (a type of white blood cell that fights infection). It is calculated by multiplying the total number of white blood cells by the percentage of neutrophils.
Complete Blood Count (CBC)	The number and types of cells circulating in the blood. A CBC is measured using laboratory tests that require a blood sample.
Differential	A breakdown of the different types of white blood cells (WBCs) that make up the total WBC count. The different types of WBCs include neutrophils, band neutrophils, lymphocytes, monocytes, eosinophils, and basophils.
Hematocrit (HCT)	The amount (percentage) of blood that is occupied by red blood cells.
Hemoglobin (HGB)	A protein in red blood cells (RBCs) that carries oxygen to cells and tissues throughout the body. The HGB test is used to check for low (anemia) or high (polycythemia) levels of hemoglobin.
Mean Corpuscular Hemoglobin (MCH)	Calculation of the average amount of hemoglobin in a single RBC; the amount is determined by the hemoglobin divided by the RBC count.
Mean Corpuscular Hemoglobin Concentration (MCHC)	Calculation of the average concentration of hemoglobin per unit volume in a single RBC; the concentration is calculated by multiplying hemoglobin by 100 and then dividing by hematocrit.
Mean Corpuscular Volume (MCV)	Calculation of the average volume of the red blood cells (RBCs); MCV is determined by the hematocrit divided by the RBC count.
Mean Platelet Volume (MPV)	The average volume of platelets in the blood.
Platelets (PLTs)	Small cells that stick to the site of a blood vessel injury where they clump up and seal off the injured blood vessel to stop bleeding. This measures the number of platelets in a sample of blood.
Red Blood Cell Distribution Width (RDW)	The numerical expression of the degree of variation in the volume of the population of RBCs. Typically, as new normal-sized cells are produced, the RDW increases.
Red Blood Cells (RBCs)	Red blood cells contain a protein called “hemoglobin” which carries oxygen to the cells and tissues of the body. The RBC count is the number of red blood cells in the blood.
White Blood Cells (WBCs)	White blood cells (leukocytes) help the body to fight infections. There are several different types of white blood cells; each type has a different function. The WBC count is the total number of all the white blood cells in the blood.

Normal Ranges of Blood Cell Counts. Normal blood cell counts fall within a range established by testing healthy children of all ages. The cell counts are compared to those of healthy individuals of similar age and sex. Nearly all lab reports include a “normal” range or high and low “values” to help you understand your child’s test results. The ranges in the chart below are for children from infancy to adolescence. Speak to members of the healthcare team to learn more about specific values for infants and young children.

Normal Ranges of Blood Cell Counts for Children	
Red Blood Cells per microliter (μL) of blood	4.0 to 5.5 million
White Blood Cells per microliter (μL) of blood	5,000 to 10,000
Platelets per microliter (μL) of blood	150,000 to 400,000
Hematocrit* % of blood composed of red blood cells	32 to 44
Hemoglobin* grams per deciliter (g/dL)	9.5 to 15.5

*The ratio of hematocrit to hemoglobin is about 3 to 1.

Your Child’s Diagnosis. Write down your child’s exact diagnosis in the space below for future reference. It’s important for all of your child’s healthcare providers to have your child’s specific diagnosis (for example, “Burkitt lymphoma,” not just the more generalized term “non-Hodgkin lymphoma”). Take your child’s medical records to all of his or her appointments with new healthcare providers and to any emergency room visits.

Questions to Ask Members of the Healthcare Team

- What is my child’s exact diagnosis?
- Is there a stage or risk category associated with my child’s cancer?
- Are there any significant genetic mutations associated with my child’s cancer?



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