LEUKEMIA

A GUIDE FOR PATIENTS AND THEIR FAMILIES

FOX CHASE CANCER CENTER
TEMPLE HEALTH

If you or a loved one has been diagnosed with leukemia, having accurate information about the disease and its treatment can help you make the best healthcare decisions. Fox Chase Cancer Center's hematologic oncologists have put together this guide to help you understand leukemia and the range of treatment options available.

INSIDE THIS GUIDE

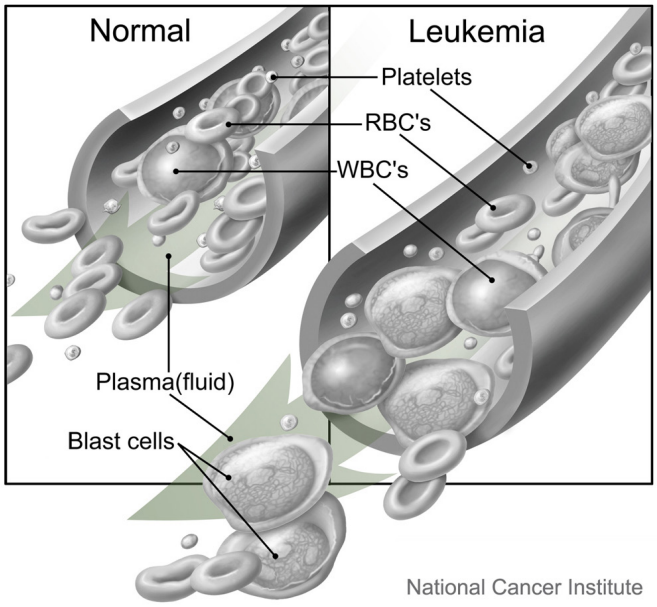
Request an appointment online or call 888-384-8458

WHAT IS LEUKEMIA?

Leukemia is a cancer of the bone marrow and blood, usually involving the white blood cells. White blood cells give your body the power to fight infection and stay healthy. But in people who develop leukemia, the bone marrow rapidly produces an uncontrollable amount of abnormal white blood cells that fail to function properly. They begin to take over the space inside the marrow and crowd out the healthy blood cells.

This results in fewer normal blood cells (and more abnormal leukemia cells) being produced and released into the blood. Without enough normal blood cells, your body's organs and tissues will not get adequate oxygen, and your body won't be able to ward off infection or clot blood when needed. Once leukemia cells are in the blood, they can spread to other parts of the body.

Unlike other cancers, leukemia generally does not form into a mass, or tumor, that can be seen on imaging tests.



Normal blood cells and blood cells with leukemia.

Types of Leukemia

The four main types of leukemia are named for the cell type — **myeloid** or **lymphoid** — and how quickly the leukemia grows. **Chronic** leukemia refers to more mature cells that grow slowly and may produce no early symptoms, while **acute** refers to less developed cells that multiply rapidly and require aggressive treatment.

Acute Myeloid Leukemia

Acute myeloid leukemia (AML) is the most common type of acute leukemia in adults, usually over age 65. AML also has numerous subtypes, based on the cell where the leukemia developed, which can affect your methods of treatment.

AML is a fast-growing cancer that develops from myeloid cells, which can produce white blood cells, red blood cells and platelets. Abnormal changes in these cells prevent them from becoming mature and able to protect the body. As they multiply, they quickly overwhelm the normal cells in the bone marrow and blood.

AML Classification and Diagnosis by Subtype

For patients with AML, knowing the subtype is very important, as it can affect the patient's outlook and treatment options. Subtypes are classified and treated according to chromosomal abnormalities, gene mutations, the patient's age and other factors. Accurate genetic testing is needed to diagnose the correct subtype of AML and determine the prognosis.

Chronic Lymphocytic Leukemia

Chronic lymphocytic leukemia (CLL) is the most common type of chronic leukemia in adults. CLL is a cancer of the B-cells, which are lymphocytes (a type of white blood cell) that make antibodies to mark germs for killing.

CLL is usually a slow-growing cancer, but over time, it results in too many abnormal B-cells that crowd out healthy cells in the bone marrow.

Chronic Myeloid Leukemia

Chronic myeloid leukemia (CML) is a rare, slow-growing cancer that occurs most often in adults over age 65. In CML, there are too many white blood cells called granulocytes.

The cells in our bodies contain genetic information organized in chromosomes. Most cells have 23 pairs of chromosomes. A cell must make a copy of its chromosomes before it divides into two cells, and sometimes mistakes occur in the copies. This is what happens in the case of CML.

CML is strongly connected with an abnormal chromosome called the Philadelphia chromosome, which makes it different from other types of leukemia. In the Philadelphia chromosome, a piece of chromosome 9 and a piece of chromosome 22 break off and trade places, known as a translocation. They then fuse together on chromosome 22, which creates the abnormal Philadelphia chromosome.

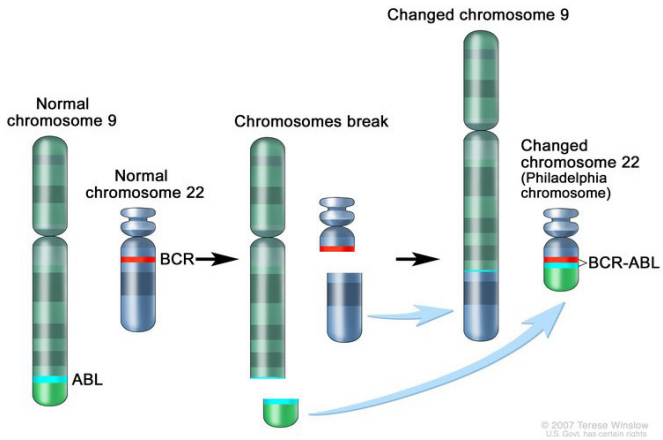
The fusion of these two pieces of chromosomes results in an abnormal gene called *BCR-ABL1*. It produces a protein that causes uncontrolled cell growth.

Acute Lymphocytic Leukemia

Acute lymphocytic (or lymphoblastic) leukemia (ALL) occurs more often in children. ALL is a cancer that involves abnormal B-cells or T-cells, which are types of lymphocytes that work together to kill germs and diseased cells. Doctors may further sub-classify ALL based on the variety and developmental stage of the lymphocyte.

CLL and SLL

Chronic lymhocytic leukemia (CLL) and small lymphocytic lymphoma (SLL) are essentially the same disease, with the only difference being the location of the cancer cells. In the case of CLL, most of the cancer cells are found in the bloodstream and bone marrow. When the cancer cells are located mostly in the lymph nodes, the disease is called SLL.



Philadelphia chromosome; three-panel drawing shows a piece of chromosome 9 and a piece of chromosome 22 breaking off and trading places, creating a changed chromosome 22 called the Philadelphia chromosome.

Other Types of Leukemia

- **Hairy cell leukemia:** abnormal change in B-cells that multiply and interfere with normal cells
- **Myelodysplastic syndromes:** not enough healthy, normal blood cells in the bone marrow
- **Myeloproliferative neoplasms:** the bone marrow makes too many blood cells

Leukemia Symptoms

Symptoms of leukemia are often vague and may feel similar to those of other common illnesses. They also depend in part on what type of leukemia is present.

Following are typical signs and symptoms of leukemia, although please note they could indicate many other conditions as well:

- Persistent fatigue, weakness and lack of energy
- Tiny red or purple spots on the skin
- Pale skin tone
- Fever or chills
- Recurrent nosebleeds
- Bleeding and bruising easily
- Unexplained weight loss
- Joint or bone pain
- Swollen lymph nodes
- Frequent infections
- Shortness of breath

Risk Factors

An increased risk of leukemia may be associated with certain genetic and environmental factors, including:

- Previous cancer treatment of chemotherapy and radiation therapy
- Certain genetic disorders such as Down syndrome
- Exposure to chemicals such as benzene, found in gasoline and used by the chemical industry
- Smoking
- Family history of the disease
- Advancing age (older than 65)
- Gender: More common in men
- Race: More common in Caucasians

Having any of these risk factors does not mean you will develop leukemia. Many people with leukemia have no risk factors. However, you should consult with your doctor if you have any concerns.

DIAGNOSING LEUKEMIA

Accurate diagnosis is essential to choosing the best treatment for your type and stage of leukemia. Fox Chase's hematopathologists — pathologists who specialize in the diagnosis of blood cancers — have specific expertise for properly diagnosing leukemia and other blood diseases. These specialists are not available at all healthcare centers and are most often found at comprehensive cancer centers.

Diagnosis of leukemia typically requires various blood tests and a bone marrow aspiration and biopsy. Molecular and genetic tests may also be used to gather more information about the leukemia, including prognosis and appropriate treatment options.

Blood Tests

A **complete blood count** (CBC) measures the levels of red and white blood cells and platelets in your blood and checks for abnormalities. The CBC is often done along with a differential, which looks at the numbers of all the different types of white blood cells and checks whether the counts are in balance with each other.

A **comprehensive metabolic panel** measures 14 substances in your blood. It provides key details about how well your organs are working and whether any problems detected could be related to blood disease. A **peripheral blood smear** involves checking a sample of blood for immature cells and for changes in the numbers and appearance of different types of blood cells.

Blood tests may show the presence of leukemia, though not all types cause leukemia cells to circulate in the blood — sometimes they remain in the bone marrow. Your doctor can also test you for autoimmune hemolytic anemia and check for high levels of lactic acid, uric acid, and LDH and other proteins, which can all be signs of different types of leukemia.

Another standard in blood testing for leukemia is to look for coagulopathy, or impairment in blood clotting. These tests measure how long it takes blood to clot or how much blood protein the liver is producing.

Bone Marrow Tests

Because leukemia starts in the bone marrow, your doctor will conduct bone marrow tests to confirm the disease. These tests include **aspiration** (removing a small amount of liquid bone marrow with a thin. Hollow needed) and a **biopsy** (removing a core sample of bone with a slightly wider needle).

Bone marrow aspiration and biopsy are often performed at the same time, with samples usually taken from the back of the hip bone and sent to a lab for study.

Immunophenotyping

Immunophenotyping uses antibodies to detect the presence or absence of white blood cell antigens, which are proteins found on the surface of white blood cells. These antigens are called biomarkers and can be targeted in AML treatment.

Immunophenotyping can detect subtle differences between different types of blood cancers and can help diagnose the subtype of AML. The tests used are called **flow cytometry** and **immunohistochemistry**, which involve treating samples of cells with a light-sensitive dye or adding a chemical marker before studying the cells and measuring their numbers, size and appearance.

Genetic Testing

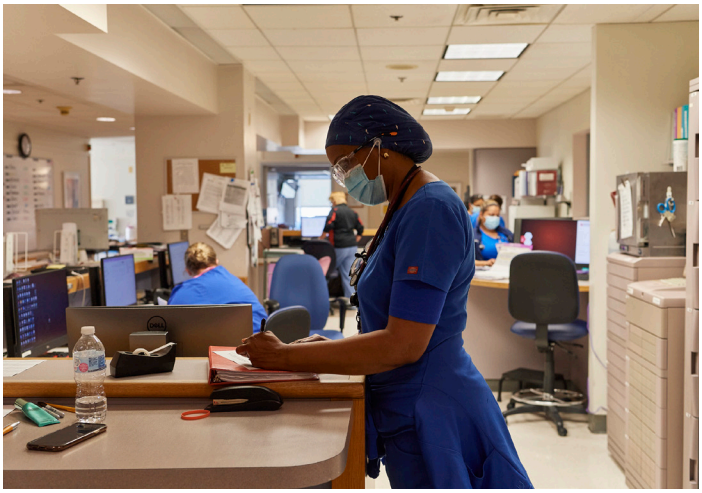
The presence of leukemia can often cause abnormal changes in chromosomes and genes. Genetic tests for these changes may assist with diagnosis and prognosis.

- **Cytogenetics:** The cells in a sample of blood, tissue and bone marrow are viewed under a microscope to look for broken, missing, rearranged or extra chromosomes. The lab tests for chromosome assessment include **karyotype** and **fluorescence in situ hybridization**.
- **Molecular testing:** This includes tests of genes or the proteins they produce, identifying the presence or absence of mutations and certain proteins that might affect treatment. Molecular testing includes a very sensitive lab process called **polymerase chain reaction** that can pinpoint one leukemia cell among more than 100,000 cells.

Other Testing

Additional tests that may be used as part of the diagnostic and assessment process for leukemia:

- Physical exam
- Medical history
- Imaging tests
- Spinal fluid tests/lumbar puncture
- Heart tests



When and where patients first seek treatment for cancer can make a big difference in recovery and survival.

At Fox Chase, patients have access to integrated, disease-specific, multidisciplinary teams of physicians who create personalized plans from diagnosis through to continuous follow-up care.

STAGING

After a patient is diagnosed with cancer, doctors will try to determine whether it has spread and how far. This process is called staging. The stage of a cancer describes how much cancer is in the body. It helps determine how serious the cancer is and the best treatments.

Staging of most cancers is based on the size and spread of tumors, but leukemia occurs in the developing blood cells of the bone marrow and does not usually present as a mass. As such, the stages of leukemia are more likely to be characterized by blood cell counts; chromosome mutations and abnormalities; and whether other organs have been affected. Doctors can use this information to determine the risk level of the disease and what treatment is most appropriate.

The categorization of your leukemia also depends on what cells it developed from and whether it is fast- or slow-growing. If you have acute myeloid leukemia (AML), the most common acute leukemia among adults, its subtype plays a key role as well. The prognosis and treatment for AML subtypes are primarily influenced by the presence or absence of certain chromosomal abnormalities and/or gene mutations.

What If I Have Already Been Diagnosed at Another Hospital?

At Fox Chase, we routinely offer second opinions, which could help confirm your diagnosis and identify new treatment options that might be more effective for your condition. In fact, it is common to seek a second opinion for a cancer diagnosis, and some insurance companies even require it.

Coming to Fox Chase also means you'll likely have greater access to clinical trials appropriate for your condition. Our designation as a Comprehensive Cancer Center by the National Cancer Institute (NCI) means we are part of a network of research centers where hundreds of clinical trials take place every day.

If you decide to seek a second opinion at Fox Chase, our team will work with you to obtain your medical records, imaging results and pathology report, or you may have your physician forward them to us.

PRIMARY LEUKEMIA TREATMENT

When treating patients with leukemia, the best outcomes result from a multidisciplinary approach to your care. After your diagnosis, your Fox Chase medical team will work closely with you to help you understand your condition and develop a customized treatment program. Treatment is based largely on the following factors:

- The type of leukemia you have, and its subtype if applicable
- The disease stage and whether it is fast- or slow-growing
- The molecular, genetic and clinical features of the disease
- Your age, health and personal goals

Acute Myeloid Leukemia

Acute myeloid leukemia (AML) is the most common type of acute leukemia among adults. AML patients should begin aggressive treatment after diagnosis, which may include chemotherapy, targeted therapy, and/or bone marrow transplantation. Participation in a clinical trial may also be possible.

Treatment has three main phases: **induction** to clear as many cancer cells as possible in hopes of achieving remission; **consolidation** to kill any remaining cells; and **maintenance** to prevent cancer from returning. Your age (younger or older than 60) and type/subtype of AML will play key roles in your treatment plan.

If leukemia returns after a period of remission, it is called a **relapse**, and further treatment will usually be

necessary. If leukemia does not go into remission and appears resistant to the initial courses of treatment, it is called **refractory**. Refractory cancer can continue to be treated as well.

CHEMOTHERAPY

Chemotherapy drugs disrupt the life cycle of cancer cells by altering the instructions that tell them how and when to grow and divide. The two types of chemotherapy for AML are **anthracyclines**, which damage the DNA in cancer cells; and **anti-metabolites**, which prevent the building blocks of DNA from being used by cancer cells, so they cannot divide into new cells.

A common treatment for AML begins with induction chemotherapy, the first phase of treatment in which a combination of drugs is used to destroy as many leukemia cells as possible and bring blood counts to normal. This is generally followed by consolidation chemotherapy to destroy any remaining leukemia cells that cannot be seen in the blood or bone marrow.

TARGETED THERAPY

Targeted therapy is a type of systemic therapy that works throughout the body and focuses on unique features of cancer cells to stop them from producing and growing. It would typically be used to target certain gene mutations and surface proteins. Targeted therapy may be used alone or combined with chemotherapy.

BONE MARROW TRANSPLANT

Through our highly ranked Bone Marrow Transplant Program, Fox Chase Cancer Center and Temple Health physicians perform bone marrow and stem cell transplantation to improve long-term outcomes for patients with blood cancers and disease including leukemia.

A bone marrow transplant, also called a stem cell transplant, infuses healthy cells into the body to replace damaged or diseased bone marrow. This procedure may be used in conjunction with chemotherapy alone or in combination with total body irradiation.

Bone marrow transplant options for leukemia include **autologous** (using your own previously collected cells) and **allogeneic** (using donated cells). Allogeneic transplants are far more common to treat AML.

For an allogeneic transplant, healthy bone marrow cells come from a matched related or unrelated donor. You will receive high-dose chemotherapy to destroy the cells that have been resistant to treatment, and the donor cells will be infused into your body. The donor cells will create new marrow with your healthy cells and will attack the cancer cells as a foreign presence.

Transplantation also is a key treatment for relapsed or refractory AML.

Chronic Lymphocytic Leukemia

Chronic lymphocytic leukemia (CLL) is the most common type of chronic leukemia among adults. Many patients with CLL do not require immediate treatment for this typically slow-growing disease.

When treatment is called for, options include targeted therapy, antibody treatment and chemotherapy. A bone marrow transplant may also be possible. The goal of treatment is to reduce symptoms and control the cancer.

TARGETED THERAPY

Targeted therapy impedes the growth process that is specific to cancer cells. For CLL, these therapies include **kinase inhibitors** that stop cell growth signals. A medication called ibrutinib, which is a Bruton's kinase inhibitor, is considered the key first-line treatment for CLL. Other options include **BCL-2 protein inhibitors**, which enable cancer cells to self-destruct.

ANTIBODY TREATMENT

Antibodies are Y-shaped proteins of the immune system that help your body detect and fight germs. **Monoclonal antibodies** can be made in a lab to treat certain types of cancer.

Some antibodies attach to the surface protein of certain cells and mark them for destruction by your

immune system, or may kill them directly. Others called **immune checkpoint inhibitors** attach to immune cells and allow your immune system to destroy the cancer cells.

CHEMOTHERAPY

Chemotherapy works by damaging cancer cells or causing them to destroy themselves. Chemotherapy is often used with antibody treatment (called chemoimmunotherapy) to treat CLL.

BONE MARROW TRANSPLANT

An allogenic transplant may be an option to treat your CLL. Healthy bone marrow cells come from a matched related or unrelated donor. You will receive high-dose chemotherapy to destroy the cells that have been resistant to treatment, and the donor cells will be infused into your body. The donor cells will create new marrow with your healthy cells and will attack the cancer cells as foreign.

Our BMT Program has been named one of the most successful transplant centers in the country by the Centers of International Blood Marrow Transplant Research.

Chronic Myeloid Leukemia

The hallmark of chronic myeloid leukemia (CML) is the Philadelphia chromosome containing the abnormal fusion gene *BCR-ABL1*. This gene makes a new protein that causes uncontrolled cell growth. Treatment for CML aims to stop the activity of that fusion protein.

The three phases of CML are called **chronic**, **accelerated** and **blast**. Phases are based on the number of immature white blood cells (blasts) in the blood and bone marrow. Blast phase may occur after additional gene mutations and treatment resistance, and it is considered life-threatening.

CML is usually treated with targeted therapy, focusing on specific or unique features of cancer cells. Chemotherapy or a bone marrow transplant may be other treatment options.

TARGETED THERAPY

Targeted therapies seek out how cancer cells grow and divide in the body. **Tyrosine kinase inhibitors** (TKIs) are a standard type of targeted therapy for CML. They stop the action of molecules that help the cancer cells survive and thrive. The protein made by the BCR-ABL1 fusion gene is a tyrosine kinase, responsible for transferring chemicals that spark cell growth.

The TKI used for your CML depends on many factors, including your age; the phase and level of risk of your disease; and whether you have other health issues such as an enlarged spleen.

CHEMOTHERAPY

Chemotherapy may be used to treat chronic or accelerated phase CML that is resistant to and/or intolerant of two or more TKIs. Doctors will monitor you closely for any issues the treatment may cause.

BONE MARROW TRANSPLANT

An allogeneic transplant is the main treatment option for advanced (accelerated or blast) CML. Healthy bone marrow cells come from a matched related or unrelated donor. You will receive high-dose chemotherapy to destroy the cells that have been resistant to treatment, and the donor cells will be infused into your body. The donor cells will create new marrow with your healthy cells and will attack the cancer cells as a foreign presence.

Acute Lymphocytic Leukemia

Treatment for acute lymphocytic leukemia (ALL) is complex. Options include chemotherapy, antibody treatment, CAR T-cell immunotherapy, TKIs, corticosteroids, radiation therapy, and bone marrow transplantation. Participation in a clinical trial may also be possible. The goal of treatment is to reduce symptoms and control the cancer.

Age, fitness level and your type of ALL will play key roles in your treatment plan, as well as whether the Philadelphia chromosome is present.

CHEMOTHERAPY

Chemotherapy is a very common treatment during the induction and consolidation phases. Your doctor will consider which of the many standard regimens is best for you and if chemotherapy should be combined with other treatments. Chemotherapy may also be helpful for T-cell ALL that has relapsed (returned after remission) or is refractory (becomes resistant to treatment).

CORTICOSTEROIDS

When chemotherapy cannot be used, corticosteroids may be an option as a lower-intensity treatment for older adults or those who may be quite sick. They are toxic to ALL cells. Corticosteroids can also help relieve inflammation and other symptoms.

TARGETED THERAPY

For certain types of ALL, targeted kinase inhibitors (TKIs) may be added to the chemotherapy treatment to stop the growth signals to cancer cells. A TKI may also be used during the maintenance period after chemotherapy or a bone marrow transplant.

ANTIBODY TREATMENT

Antibodies are proteins of the immune system that help your body fight germs. Monoclonal antibodies can be made in a lab to help fight certain types of cancer. They attach to cells to mark them for destruction by your immune system, or they may directly kill cells.

BONE MARROW TRANSPLANT

An allogeneic transplant may be a treatment option for consolidation depending on the type of ALL you have and whether induction treatment is successful, among other factors. Your doctor will discuss the viability of this option with you.

CAR T-CELL IMMUNOTHERAPY

Chimeric antigen receptor (CAR) T-cell therapy has proved to be a successful treatment option for certain leukemias in patients who have shown resistance to chemotherapy and either have failed a transplant or are not considered a viable transplant candidate.

CAR T-cell therapy reprograms a patient's own T-cells to recognize and destroy cancer cells. It is a type of immunotherapy, which harnesses the power of the body's own immune system to fight cancer.

T-cells are a type of white blood cell that search out and kill abnormal cells, bacteria, viruses and other invaders that the immune system does not recognize. Because cancer cells are the body's own cells that are growing and dividing out of control, they may avoid detection.

To manufacture CAR T-cells, blood is drawn from the patient and T-cells are extracted. The T-cells are sent to a specialized laboratory where scientists genetically modify them by adding a special receptor (CAR) that guides the T-cells to find and eliminate cancer cells. The newly altered T-cells are multiplied by the millions in the lab and sent back to the hospital.

As this process is occurring, patients receive a short course of low-dose chemotherapy before the modified T-cells are infused back into the bloodstream, where they attach to the residual cancer cells and destroy them.

RADIATION THERAPY

Radiation therapy uses high-energy X-rays to treat ALL in the brain. The X-rays damage DNA in cancer cells, killing them or stopping new growth.

FOR PEDIATRIC PATIENTS

Acute lymphocytic leukemia (ALL) is the most common form of leukemia for children but is not often seen in adults. Fox Chase treats adults diagnosed with leukemia. If you are looking for a cancer treatment center for a child, please visit the National Cancer Institute at cancer.gov/research/infrastructure/cancer-centers for a comprehensive listing of hospitals.

FOX CHASE-TEMPLE UNIVERSITY HOSPITAL BONE MARROW TRANSPLANT PROGRAM

Through our highly ranked Bone Marrow Transplant Program, Fox Chase Cancer Center physicians and Temple Health staff provide bone marrow and stem cell transplantation to improve long-term outcomes for patients with leukemia and other blood-related disorders. Our multidisciplinary program includes board-certified hematologic oncologists with specific expertise in transplantation and caring for patients undergoing transplants in cellular therapy.

Our BMT Program has been named one of the most successful transplant centers in the country by the Centers of International Blood Marrow Transplant Research. We perform 100-150 blood and bone marrow transplants a year at our 11,500-square-foot clinic, which occupies the entire fifth floor of the Patient Care Center at Temple University Hospital – Jeanes Campus.

We also are fully accredited by the Foundation for the Accreditation of Cellular Therapy (FACT) — the gold standard of excellence for blood and bone marrow transplant programs in the United States — and the National Marrow Donor Program (NMDP). We meet and exceed the rigorous criteria established by these organizations based on the high number of transplants we perform, our level of expertise, and the support personnel available to care for patients.

Our physicians have performed thousands of bone marrow and stem cell transplants, using cells from your own body or from matching donors. The type of transplant you receive is determined by your diagnosis, stage of disease, overall health and age. Our BMT Program is also one of very few in the United States to offer bloodless transplant procedures for patients who request this complex technique.

Other key elements of our BMT Program:

- Patients in need of transplants are not denied treatment because of age. Nearly 25% of our patients are older than 65.
- Temple University Hospital has earned the status of "Blue Distinction Center for Transplants" from IBC in recognition of the BMT Program's expertise in performing adult bone marrow transplants.
- In 2020, the BMT Program was reaccredited for adult allogeneic and autologous hematopoietic progenitor cell transplantation, peripheral blood cellular therapy product collection, and cellular therapy product processing with minimal manipulation. Also included was a new accreditation for immune effector cells.
- We actively participate in research from our own institutions, the ECOG-ACRIN Cancer Research Group and the Bone Marrow Clinical Trials Network (BMT-CTN). Our researchers work collaboratively to bring the most promising discoveries from the laboratory into the clinical setting, where they can directly impact patients.

Request an appointment online or call 888-384-8458

About Bone Marrow Transplants

A bone marrow transplant, also called a stem cell transplant, infuses healthy cells into the body to replace damaged or diseased bone marrow. Bone marrow is the soft, spongy center of the bone that contains the stem cells that produce white blood cells, red blood cells and platelets, which all work to keep the body healthy.

Bone marrow transplantation is a common treatment option for acute leukemias. It may be used in conjunction with chemotherapy alone or in combination with total body irradiation.

Depending on the type of leukemia you have and how advanced it is, a bone marrow transplant may be needed if:

- Your body cannot make the blood cells it needs because your bone marrow or stem cells have failed.
- Your bone marrow or blood cells have become diseased and need to be replaced with healthy cells.
- You have a disease being treated with high doses of chemotherapy and/or radiation treatment, which destroys both cancerous and healthy cells.

Our team offers allogeneic, autologous and haploidentical transplantation, although for leukemia, most transplants are allogeneic. The type of transplant you receive is determined by several factors, including your diagnosis, stage of disease, overall health and age.

- **Allogeneic**: Healthy bone marrow cells come from a closely matched donor.
- **Autologous**: Healthy bone marrow cells come from the patient.
- **Haploidentical**: Healthy bone marrow cells come from related donors that are not a complete match for the patient.

BMT Support Services

The Fox Chase-Temple Bone Marrow Transplant Program offers support services to help you and your family deal with the emotional, physical and social challenges that often accompany transplantation. You will have access to:

- Transplant coordinators who will walk you through all aspects of a bone marrow transplant and coordinate your care
- A complete set of consulting physicians for internal medicine and surgical issues, as well as the close support of a medical intensive care unit when necessary
- Interventional radiologists who assist with placement of indwelling catheters
- Licensed social workers who work closely with patients, caregivers and family during and after the transplant process
- Regular support and educational group meetings
- A board-certified psychiatrist who specializes in psychopharmacology
- A certified nutritionist to help with dietary issues
- Palliative care, which focuses on improving the quality of life for patients and their families through the management of symptoms, pain and stress brought on by a serious illness
- Integrative care, which explores a body/mind/spirit approach to healing

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ALLOGENEIC TRANSPLANTS

For an allogeneic transplant, healthy bone marrow cells come from a matched donor who could be related or unrelated to you. You will receive high-dose chemotherapy to destroy the cells that have been resistant to treatment, and the donor cells will be infused into your body. The donor cells will create new marrow with your healthy cells and will attack the cancer cells as a foreign presence.

We make every effort to use donated cells that are as closely matched as we can identify. The best chance for finding a match is with a full sibling, where there is typically about a 25 percent chance of matching.

If a patient doesn't have a family member who is a close match, there may be other options:

- **Donor registries**: Hospitals have access to national and international registries where volunteers have offered to donate their stem cells or bone marrow cells if they are found to be a match. We perform tissue typing on our patients, submit it to the registry, and generate a list of potential matches. If a potential match is found, additional testing is performed, and the cells can be collected remotely and shipped for transplantation.
- **Cord blood**: A national cord blood bank is available, which involves blood taken from the umbilical cord when babies are born. Those cells can be frozen and added to the national bank. A list of potential matches within this bank can be generated by recording the patient's blood type and tissue type. Patients can also have their baby's stem cells collected and frozen for their own future use if needed.

Before a transplant using donor cells, you will undergo a test called HLA typing. The human leukocyte antigen (HLA), a protein found on the surface of most cells, plays a key role in your body's immune response. HLAs are unique to each person and mark your cells so your body knows they are yours.

During HLA typing, your proteins will be compared with the donor's white blood cells to see how many proteins are the same so you can find the best match for your transplant. Otherwise, your body will reject the donor cells.

AUTOLOGOUS TRANSPLANTS

Autologous transplants are sometimes used for people with AML who are in remission after initial treatment and who don't have a matched donor for an allogeneic transplant.

With autologous transplants, it is often difficult to separate normal stem cells from leukemia cells in the bone marrow or blood samples. Even after purging (treating the stem cells in the lab to try to kill or remove any remaining leukemia cells), the risk exists of returning some leukemia cells with the transplant.

What is a Bone Marrow Transplant?

When people hear the term "transplant," they may typically think of an operation, but a bone marrow transplant is not a surgical process. Stem cells are given back to the body in the same manner as a blood transfusion – the cells are pushed into the IV tubing, travel back to the marrow, and start to make a new population of healthy blood cells.

HAPLOIDENTICAL TRANSPLANTS

With haploidentical transplants, a family member may be able to donate cells for a transplant even if he or she is not a match. In the past, mismatched cells often caused serious complications with high rates of graft-versus-host disease, but today doctors can use a combination of chemotherapy treatments after the transplant to suppress those cells and try to avoid negative reactions.

BLOODLESS TRANSPLANTS

Some patients have opposition to receiving blood or blood products from any person other than themselves, even family members. This may be true for religious reasons, safety or any other personal reason.

As a result, interest has grown in minimizing blood transfusions and in performing operations or bone marrow transplants without offering transfusions. The Fox Chase-Temple University Health Bone Marrow Transplant Program is a referral center for bloodless transplants, which involve no blood or blood products from other donors.

Many patients can be successfully supported through an autologous transplant without giving red blood cells or platelets. At Fox Chase, with careful support, we minimize the amount of blood that we take during the course of the transplant, by safely doing blood tests less often and by using much smaller tubes that take less blood for testing.

The red blood cells that our bodies make typically last for months, so most of the cells that patients come into the transplant with are still viable. In addition, the body makes new red blood cells every day, so there is a slow decrease in the blood count. As a result, the outcomes are very similar to those of patients who receive blood products.

Multiple Bone Marrow Transplants

Some people have more than one bone marrow transplant:

- After a first transplant, a patient may receive maintenance therapy to keep the abnormal cells at their lowest level for as long as possible – sometimes for years – and then undergo a second transplant whenever the disease strengthens again.
- Some patients may plan to receive two autologous transplants within three months to maximize the chance for a cure.
- Patients with lymphomas who relapse after an autologous transplant can sometimes be cured with an allogeneic transplant.

The Bone Marrow Transplant Program includes board-certified hematologic oncologists with specific expertise in transplantation and caring for patients undergoing transplants in cellular therapy.

CLINICAL TRIALS

Engagement in numerous clinical trials allows Fox Chase to be at the forefront of new treatment options. For leukemia patients, clinical trials are often recommended when available. We are proud to be able to offer our patients the most recent advances and most promising treatments for leukemia.

As the final steps in testing a treatment's safety and efficacy before it is recommended for general use, clinical trials may give patients access to new procedures that aren't yet widely available, or to drugs and medical devices before they are approved by the Food and Drug Administration. A clinical trial may also be used to test ideas about diagnosing cancer, preventing cancer, or managing symptoms or side effects.

The cancer treatments used today are products of previous clinical trials, and the trials taking place now will help determine how we approach cancer in the future.

For a complete list of leukemia clinical trials at Fox Chase, please visit our website.

GETTING THE BEST CARE FOR LEUKEMIA

What should patients with leukemia look for when they are deciding where to get their treatment to ensure the best possible outcome? Consider these factors:

- At Fox Chase, leukemia patients receive the most sophisticated care with a wide range of state-of-the-art treatment options.
- For the second year in a row, the one-year survival rate of the Fox Chase-Temple Health Bone Marrow Transplant Program is above the expected survival rate, when compared with those of similar patients transplanted throughout the United States. Our program was one of 17 U.S. transplant centers that achieved this recognition in 2020 and is the only center with this distinction in the tri-state area (Pennsylvania, New Jersey and Delaware).
- Fox Chase Cancer Center doctors are not just clinical specialists—they're also world-renowned cancer researchers. The results of studies conducted by Fox Chase physicians have been crucial in advancing our understanding of leukemia diagnosis and treatment around the world. Our robust clinical trials program is key to the advancements we make in the cancer field.

WHY CHOOSE FOX CHASE?

Fox Chase Cancer Center:

- Has received the highest designation from the National Cancer Institute (NCI) as a Comprehensive Cancer Center, an elite center recognized for excellence in cancer treatment, research, prevention and education
- Offers a multidisciplinary team of physician leaders in the hematologic field
- Provides a full spectrum of care for every type and stage of leukemia — from detection through survivorship
- The Fox Chase-Temple University Hospital Bone Marrow Transplant Program is a national leader in performing transplants for patients with multiple myeloma, leukemia, lymphoma and other blood disorders
- Offers access to clinical trials for emerging and innovative therapies for multiple myeloma

When you or someone you care about is faced with the risk or diagnosis of leukemia, you will want medical advice and care from experienced and compassionate professionals who are leaders in their field. At Fox Chase, we have offered comprehensive approaches to diagnosis, treatment and follow-up support for more than 100 years.

Our multidisciplinary hematologic specialists not only are using some of the latest treatments and technology available, but also are involved in clinical trials and risk assessment research. Clinical trials and research may offer patients access to innovative treatments today and breakthroughs in the future.

In addition, we take a comprehensive approach to treating your condition, with nurse educators, social workers and other specially trained staff members who truly make a positive difference during a difficult time. These support staff members provide emotional support, advice and coping strategies when they are needed most.

We hope that you've found this guide to be a useful resource. If you have further questions about multiple myeloma, please contact Fox Chase at 215-214-3122.