NCCN GUIDELINES FOR PATIENTS®

2018

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Acute Myeloid Leukemia

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National Comprehensive Cancer Network
Guiding Treatment, Changing Lives.

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LEARNING that you have cancer can be overwhelming.

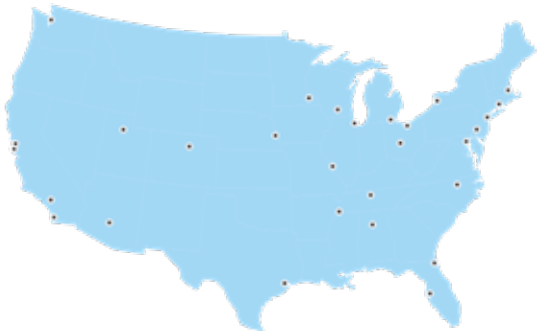
The goal of this book is to help you get the best care. It presents which tests and treatments are recommended by experts in leukemia.

The National Comprehensive Cancer Network® (NCCN®) is a not-for-profit alliance of 27 leading cancer centers. Experts from NCCN have written treatment guidelines for doctors who treat leukemia. These treatment guidelines suggest what the best practice is for cancer care. The information in this patient book is based on the guidelines written for doctors.

This book focuses on the treatment of acute myeloid leukemia. Key points of the book are summarized in the related NCCN Quick Guide™. NCCN also offers patient resources on chronic myeloid leukemia (CML), acute lymphoblastic leukemia (ALL), chronic lymphocytic leukemia (CLL), as well as other cancer types. Visit NCCN.org/patients for the full library of patient books, summaries, and other resources.

About

National Comprehensive Cancer Network®



These patient guidelines for cancer care are produced by the National Comprehensive Cancer Network® (NCCN®).

The mission of NCCN is to improve cancer care so people can live better lives. At the core of NCCN are the NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®). NCCN Guidelines® contain information to help health care workers plan the best cancer care. They list options for cancer care that are most likely to have the best results. The NCCN Guidelines for Patients® present the information from the NCCN Guidelines in an easy-to-learn format.

Panels of experts create the NCCN Guidelines. Most of the experts are from NCCN Member Institutions. Their areas of expertise are diverse. Many panels also include a patient advocate. Recommendations in the NCCN Guidelines are based on clinical trials and the experience of the panelists. The NCCN Guidelines are updated at least once a year. When funded, the patient books are updated to reflect the most recent version of the NCCN Guidelines for doctors.

For more information about the NCCN Guidelines, visit NCCN.org/clinical.asp.

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NCCN FOUNDATION®
Guiding Treatment, Changing Lives.

NCCN Foundation was founded by NCCN to raise funds for patient education based on the NCCN Guidelines. NCCN Foundation offers guidance to people with cancer and their caregivers at every step of their cancer journey. This is done by sharing key information from leading cancer experts. This information can be found in a library of NCCN Guidelines for Patients® and other patient education resources. NCCN Foundation is also committed to advancing cancer treatment by funding the nation's promising doctors at the center of cancer research, education, and progress of cancer therapies.

For more information about NCCN Foundation, visit NCCNFoundation.org.

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An an organization that strongly supports educating patients and physicians about bone marrow failure diseases like aplastic anemia, MDS, and PNH, as well as related diseases like AML, the Aplastic Anemia and MDS International Foundation is proud to support this comprehensive resource for patients and their families. www.aamds.org

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Blood & Marrow Transplant Information Network (BMT InfoNet) provides information and support services to patients undergoing a bone marrow, stem cell or cord blood transplant service. Our mission is to empower patients and their loved ones with reliable information and support about issues before, during and after transplant so that they may take an active, informed role in managing their healthcare choices. Visit us online at bmtinfonet.org, or contact us by email at help@bmtinfonet.org and by phone 847-433-3313. bmtinfonet.org

Leukemia & Lymphoma Society
LLS is dedicated to developing better outcomes for blood cancer patients through research, education and patient services and is happy to have this comprehensive resource available to patients. LLS.org/informationspecialists

National Bone Marrow Transplant Link (nbmtLINK)
Educating and informing people about their cancer diagnosis as well as the transplant process is an important part of the National Bone Marrow Transplant Link's mission and contributes to the psychosocial support of bone marrow/ stem cell transplant patients and their caregivers. For information and resources, please visit nbmtlink.org, call toll free at 800-LINK-BMT or e-mail, info@nbmtlink.org. The LINK is supportive of resources like the NCCN Guidelines for Patients. nbmtlink.org

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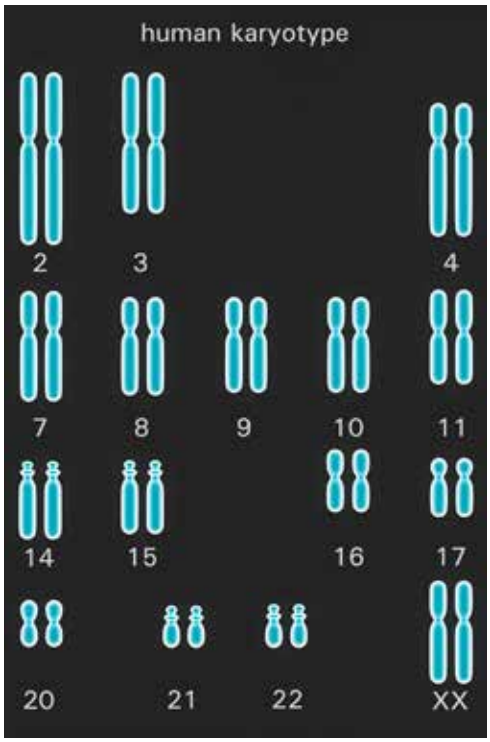
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Contents

How to use this book

Who should read this book?

Treatment options for acute myeloid leukemia are the focus of this book. This type of leukemia is also known as AML, for short. It is the most common acute leukemia in adults. Patients and those who support them—caregivers, family, and friends—may find this book helpful. It is a good starting point to learn what your options may be.

Are the book chapters in a certain order?

Early chapters explain concepts that are repeated in later chapters. **Part 1** explains what AML is. Knowing more about this leukemia may help you better understand its treatment. Tests that doctors use to confirm and plan treatment for AML are described in **Part 2**.

Parts 3 through 5 address treatment. **Part 3** lists treatment options for APL (**a**cute **p**romyelocytic **l**eukemia). **Part 4** lists treatment options for non-APL subtypes. Tips for making treatment decisions are presented in **Part 5**.

Does this book include all options?

This book includes treatment options for most people. Your treatment team can point out what applies to you. They can also give you more information. While reading, make a list of questions to ask your doctors.

The treatment options are based on science and the experience of NCCN experts. However, their recommendations may not be right for you. Your doctors may suggest other options based on your health and other factors. If other options are given, ask your treatment team questions.

Help! What do the words mean?

In this book, many medical words are included. These are words that your treatment team may say to you. Most of these words may be new to you. It may be a lot to learn.

Don't be discouraged as you read. Keep reading and review the information. Ask your treatment team to explain a word or phrase that you do not understand.

Words that you may not know are defined in the text or in the *Dictionary*. Acronyms are also defined when first used and in the *Glossary*. Acronyms are short words formed from the first letters of several words. One example is DNA for **d**eoxyribo**n**ucleic **a**cid.

1
Leukemia basics

You've learned that you have or may have a blood cancer. It's common to feel shocked and confused. This chapter reviews some basics that may help you learn about leukemia.

Blood

To learn about AML (**a**cute **m**yeloid **l**eukemia), you first must know about blood. Blood is one of the fluids in the body. It consists of blood cells that move within plasma. Plasma is mostly water.

Blood cells

There are three main types of blood cells. One type is red blood cells (also called erythrocytes). Another type is white blood cells (leukocytes). The third type is platelets (thrombocytes).

Blood cells have important jobs. Red blood cells carry oxygen throughout the body. White blood cells help fight germs. Platelets help control bleeding.

Your blood cells don't live forever. Many have a short lifespan. Thus, blood cells are being replaced in your body all the time.

Blood cell formation

Most blood cells are formed in bone marrow. Bone marrow is the sponge-like tissue in the center of most bones. **See Figure 1**.

Within your bone marrow are blood-forming cells. Blood stem cells are the cells from which all blood cells are formed. They are also called hematopoietic stem cells. As shown in **Figure 2**, they start the family tree of blood cells.

Blood stem cells can make exact copies of themselves. They can also make new cells that are a step closer to being a blood cell. These cells are called progenitor cells. Compared to stem cells, progenitor cells are set to become a certain type of blood cell.

There are two types of blood progenitor cells. Lymphoid progenitor cells start one branch of the family tree. Myeloid progenitor cells start another branch. Progenitor cells form into blast cells. Blasts are very young blood cells that can't function like mature blood cells.

At the end of the lymphoid branch is a type of white blood cell called lymphocytes. There are three types of lymphocytes. They are natural killer cells, B cells, and T cells. Lymphocytes are released from bone marrow into the bloodstream.

At the end of the myeloid branch are white blood cells, red blood cells, and platelets. These white blood cells are called granulocytes. Granulocytes include neutrophils, eosinophils, and basophils. Red blood cells, platelets, and granulocytes are released from bone marrow into the bloodstream.

"I had been battling a "cold" that wouldn't get better. My doctor ordered blood work and called to say, "I've got some bad news…you have leukemia." I didn't even know what leukemia was really.

– Matt
Cancer survivor
Diagnosed at age 29

Figure 1
Bone marrow

Bone marrow is the sponge-like tissue in the center of most bones. Most blood cells are formed in bone marrow.

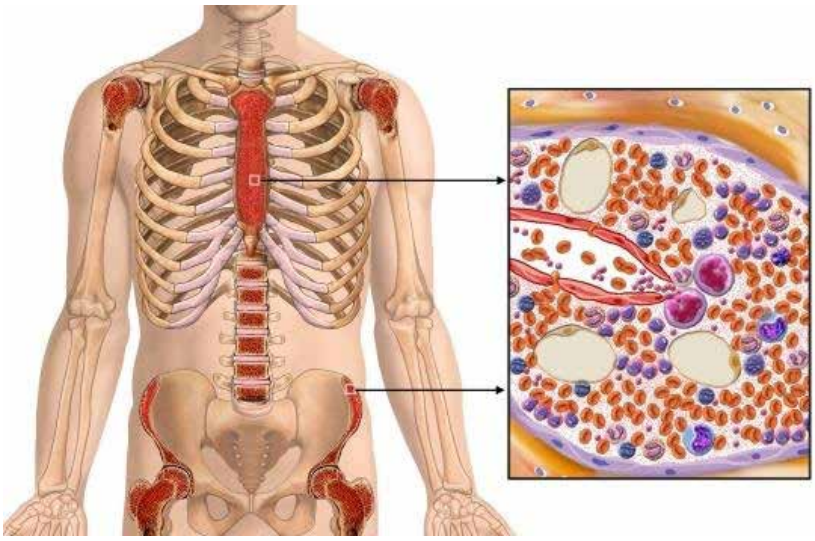
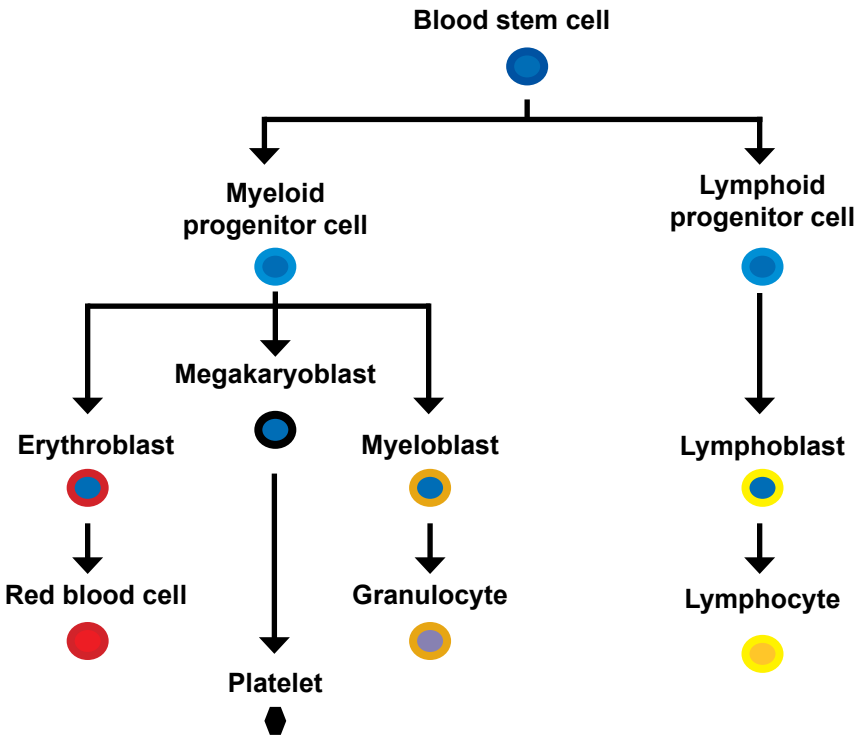


Figure 2
Blood cells

Blood (hematopoietic) stem cells are the cells from which all blood cells are formed. They make two types of progenitor cells. Lymphoid progenitor cells form into white blood cells called lymphocytes. Common myeloid progenitor cells form into red blood cells, platelets, and white blood cells called granulocytes.



A disease of cells

Your body is made of trillions of cells. Cancer is a disease of cells. Each cancer is named after the type of cell from which the disease started. Leukemias are cancers of blood cells.

AML is a cancer of myeloid precursor blood cells. Changes in these cells stop myeloid blasts from becoming mature blood cells. As a result, there is a buildup of blasts in the marrow and blood. In turn, there are too few red blood cells, platelets, and granulocytes.

Abnormal cell changes

Cells have a control center called the nucleus. The nucleus contains chromosomes. Chromosomes are are long strands of DNA (**d**eoxyribo**n**ucleic **a**cid) tightly wrapped around proteins. **See Figure 3**. Within DNA are coded instructions for building new cells and controlling how cells behave. These instructions are called genes.

There are often abnormal changes in genes within cancer cells. These abnormal changes are called mutations. Mutations cause cancer cells to not behave like normal cells. Also, mutations sometimes cause cancer cells to look very different from normal cells.

AML may be caused by two classes of mutations. One mutation causes the cells to quickly grow and divide when not needed. **See Figure 4**. The second mutation stops the cells from becoming mature blood cells.

Leukemia's threat

Leukemia results in a lack of mature blood cells. Without these cells, health problems will develop. Some of these health problems may be severe.

Low numbers of red blood cells is called anemia. Anemia may cause you to feel tired and look pale. You may also be short of breath and have problems breathing.

A shortage of platelets may cause bleeding. You may get nose bleeds. Your gums may easily bleed. Your skin may look bruised due to bleeding underneath. If you have menstrual periods, you may have heavy bleeding. Bleeding from advanced AML can be fatal.

You may have frequent infections if you have too few white blood cells. Infections may be mild or severe. Fevers may be present. Infections from advanced AML can be fatal.

> "It was my 60th birthday and I got the gift that keeps on giving. I was immediately hospitalized. The doctor said that I probably had 2 days to live. I survived hour to hour and made it through the first month in the hospital.
>
> – Chris
> Cancer survivor for 9 years

Figure 3
Genetic material in cells

Most human cells contain a plan called the "blueprint of life." It is a plan for how our bodies are made and work. It is found inside of chromosomes. Chromosomes are long strands of DNA that are tightly wrapped around proteins. Genes are small pieces of DNA. Humans have about 20,000 to 25,000 genes.

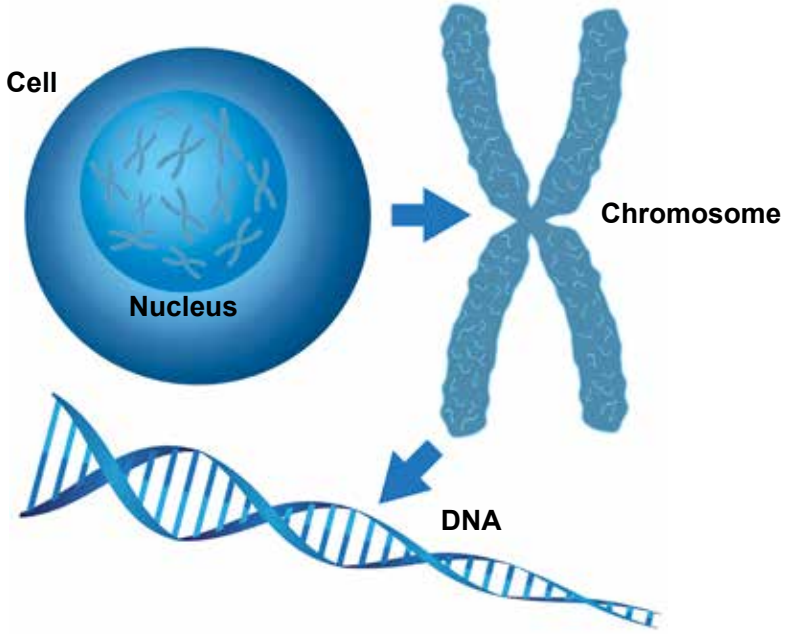
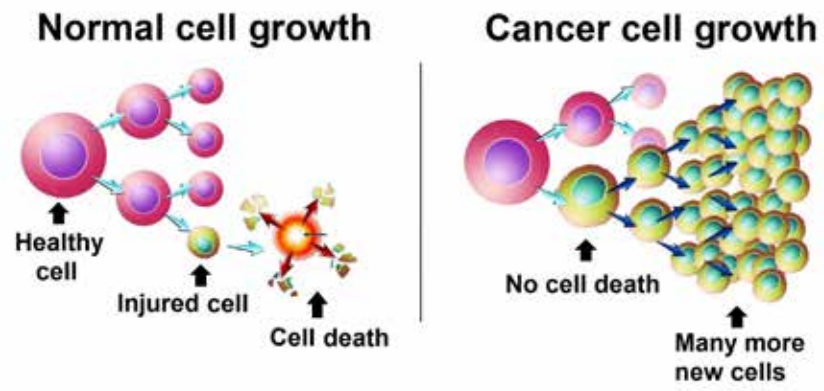


Figure 4
Normal cell growth vs. cancer cell growth

Normal cells increase in number when they are needed and die when old or damaged. In contrast, leukemia cells quickly make new cells and live longer because of abnormal changes in genes.



AML doesn't often spread outside the bloodstream. It invades the lining of the spinal cord or brain in fewer than 3 out of every 100 people. It spreads to other organs in about 1 out of 100 people. Outside the bloodstream, blasts can crowd out normal cells and cause organ failure.

Review

- Blood stem cells are the cells from which all blood cells are formed. They change into progenitor cells then into young blood cells called blasts.
- AML is a cancer of precursor blood cells within the myeloid branch.
- AML results in a lack of mature blood cells. Without these cells, severe health problems can develop.

It was a shock and hard to digest. Breaking down and crying was part of the process. I decided early in the treatment to reach out to old friends and ex-colleagues to share the news and draw on their positive emails and support. This helped a lot as I was often answering emails and supplying updates. It was therapeutic.

– Adam
Cancer survivor
Diagnosed at age 67

2
Testing for AML

Your doctor may think you have a blood cancer. This chapter describes the tests used to diagnose acute leukemia. It also describes tests used for treatment planning.

Medical history

Your doctor will ask about health problems and treatment during your lifetime. Be prepared to tell what illnesses and injuries you have had. You will also be asked about health conditions and symptoms. It may help to bring a list of old and new medicines to your doctor's office.

Some cancers and other health conditions can run in families. Thus, your doctor will ask about the medical history of your close blood relatives. Such family includes your siblings, parents, and grandparents. Be prepared to tell who has had what diseases and at what ages.

A medical history is needed for diagnosis and treatment planning. See Guide 1 for a complete list of care that is advised prior to treatment.

Physical exam

A physical exam is a study of your body. It is done to look for signs of disease. It is also used to help assess if certain treatments may be too harsh.

To start, your basic body functions will be measured. These functions include your temperature, blood pressure, and pulse and breathing rate. Your weight will also be checked.

Your doctor will listen to your lungs, heart, and gut. He or she will also assess your eyes, skin, nose, ears, and mouth. Parts of your body will be felt. Your doctor will note the size of organs and if they feel soft or hard. Tell your doctor if you feel pain when touched.

Guide 1. Tests for acute leukemia

Test name
• Medical history
• Physical exam
• CBC with differential
• Comprehensive metabolic panel ◦ LDH ◦ Uric acid
• Prothrombin time
• Partial thromboplastin time
• Fibrinogen
• Bone marrow aspiration and biopsy
• Immunophenotyping
• Cytochemistry
• Cytogenetics with karyotype ± FISH
• Molecular testing
• HLA typing
• CT scan of brain if there may be bleeding
• Brain MRI with contrast if there may be swelling
• Lumbar puncture if symptoms present
• Echocardiogram or MUGA if needed

Blood tests

Blood tests are useful for diagnosing AML. They can help to find other diseases, too. They require a sample of your blood. Samples of blood can be removed with a blood draw.

Blood draw

Some blood draws require no eating and drinking for hours. Your doctor will say if you can eat or drink. Blood samples will be removed with a needle placed into your vein. The samples will be tested by a pathologist. A pathologist is a doctor who's an expert in testing cells to find disease.

CBC with differential

A CBC (**c**omplete **b**lood **c**ount) measures parts of the blood. It is a key test that gives a picture of your overall health. Test results include counts of white blood cells, red blood cells, and platelets. AML often causes low counts of healthy blood cells.

There are several types of white blood cells. A differential counts the number of each type of cell. It also checks if the counts are in balance with each other. This test may show a high number of blasts in the blood.

Comprehensive metabolic panel

Chemicals in your blood come from your liver, bone, and other organs. A comprehensive metabolic panel often includes tests for up to 14 chemicals. Low or high levels can be caused by cancer or other health problems. Some chemicals in the panel include:

LDH

LDH (**l**actate **de**hydrogenase) is a protein that is in most cells. Dying cells release LDH into blood. Fast-growing cells also release LDH. High levels of LDH can be a sign of AML and its outcome.

Uric acid

Uric acid is released by cells when DNA breaks down. Too much uric acid in the body is called hyperuricemia. With AML, it can be caused a fast turnover of white blood cells. Testing of uric acid is advised to assess the outcome of AML.

Blood clotting tests

Your body stops bleeding by turning blood into a gel-like form. The gel-like blood forms into a solid mass called a blood clot. Proteins, called coagulation factors, are needed for clotting. They are made by the liver.

An impaired clotting process is common in leukemia. You may have bleeding and bruises. There are three tests that assess for clotting problems.

- **Prothrombin time** is a measure of how well all coagulation factors work together.
- **Partial thromboplastin time** assesses coagulation factors from two of three pathways.
- **Fibrinogen activity** is a measure of how much fibrinogen— a blood protein—is being made.

"My treatment team was amazing. They always discussed what was being done and were very caring.

– Lew
Cancer survivor
Diagnosed at age 71

Bone marrow tests

To diagnose AML, samples of bone marrow must be removed. Lab results will be used to confirm the disease. Your bone marrow will also be tested during treatment to check results.

Aspiration and biopsy

Two procedures are used to remove bone marrow. A bone marrow aspiration removes a small amount of liquid bone marrow. A bone marrow biopsy removes a core of bone.

These procedures may be done at the same time. They are performed on the back of the hip bone. You may be given a pill to help you relax.

You will likely lie on your side as shown in **Figure 5**. Some people lie on their belly. Your doctor will first clean and numb your skin. The outer surface of your bone will be numbed, too.

For aspiration, a hollow needle will be pushed through your skin and into the bone. Liquid bone marrow will then be drawn into a syringe. For the biopsy, a wider needle is used to remove a core sample. The samples will be sent to a lab for testing. You may feel bone pain at your hip for a few days. Your skin may bruise.

Cytochemistry

This test detects the type of proteins within cells. Cells from the marrow samples will be stained. Then, the stained cells will be studied with a microscope. The stains will show if proteins of myeloid cells are present.

Immunophenotyping

This test is used to detect which cell type is present. It detects proteins on the surface of cells. The proteins on leukemia cells often differ from those on normal cells. Surface proteins are often targets for treatment. There are two testing methods.

IHC

The IHC (**i**mmuno**h**isto**c**hemistry) method involves adding a chemical marker to cells. The cells are then studied using a microscope.

Flow cytometry

This method involves adding a light-sensitive dye to cells. The dyed cells will be passed through a machine. The machine measures surface proteins on thousands of cells.

Cytogenetics

Cytogenetics is the study of chromosomes. Chromosomes are often not normal in AML cells. Testing is done to look for common defects. Results help confirm AML and predict its outcome. The type of AML will also be identified for treatment planning.

Karyotype

A karyotype is a picture of chromosomes. **See Figure 6**. It is produced in about a week. Doctors look for whether 23 pairs of chromosomes are present. They also look for missing pieces of chromosomes.

FISH

FISH (**f**luorescence **i**n **s**itu hybridization) may be done, too. This method involves special color dyes—called probes—that attach to DNA parts. Doctors can then look for defects. A translocation is the switching of parts between two chromosomes. An inversion is a switching of parts within one chromosome.

Molecular testing

Molecular testing includes tests of genes or their products (proteins). It can detect fusion genes made by translocations. Test results are used to predict the outcome of AML. Results may also be used for treatment planning. Many genes will be tested. These genes include *FLT3*, *NPM1*, *CEBPA*, *IDH1*, *IDH2*, *TP53*, and *KIT*.

Figure 5
Bone marrow exam

Samples of bone and marrow are removed with a bone marrow aspiration and biopsy. These procedures are often done on the back of the hip.

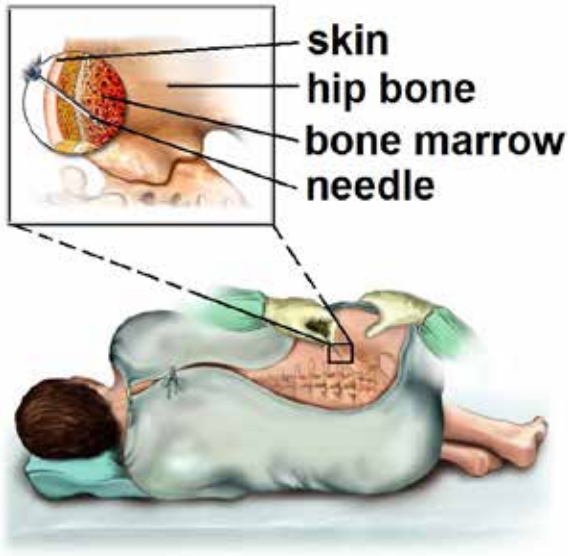
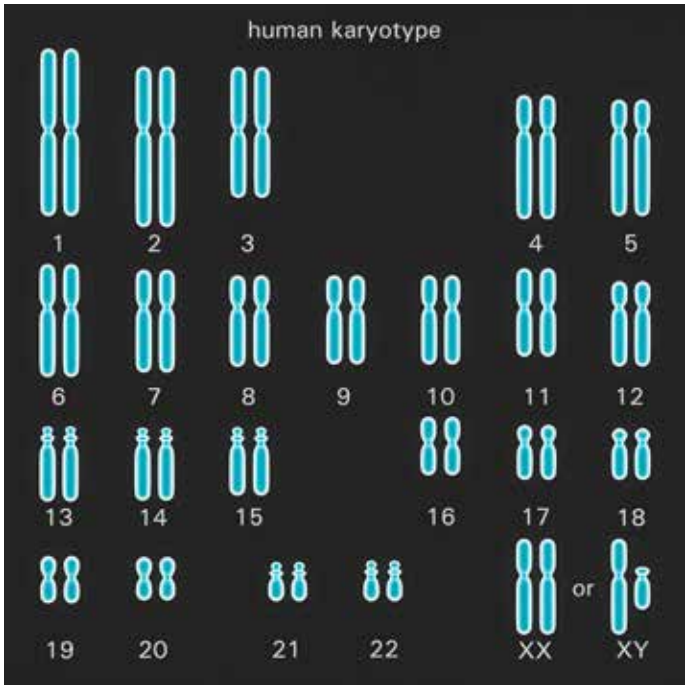


Figure 6
Karyotype

A karyotype is a picture of the chromosomes in cells. It is a test that shows abnormal changes in chromosomes.



PCR
PCR (**p**olymerase **c**hain reaction) is a test that can assess for genes. The test consists of a process in which millions of copies of a DNA part are made. PCR is very sensitive. It can find one leukemia cell among more than 100,000 cells.

HLA typing

HLAs (**h**uman **l**eukocyte **a**ntigens) are proteins found on the surface of most cells. They are markers of your body's cells. Your body detects these markers to tell which cells are its own.

HLAs do not differ between cells within a person. In other words, all your cells have the same set of HLAs. Each person's set of HLAs is called the HLA type or tissue type.

HLA typing is a test that detects a person's HLA type. This test is needed if a transplant of blood stem cells from a donor may be a treatment option. Blood samples from you and your family members will be tested.

"

My son was fourteen years old. The bloodwork revealed AML, and in-patient chemotherapy began the next day. Through the national Be The Match Registry®, an unrelated donor was located for a bone marrow transplant. My son is now 27-years-old and a college graduate. Our family is thankful for his treatment team and to the stranger who gave him the gift of life.

– Wendy
Proud mom and caregiver

Imaging

Leukemia can spread outside the bloodstream. It rarely spreads to the lining of the brain and spinal cord. It can spread to disease-fighting structures called lymph nodes. It can also spread to the liver, spleen, and skin.

Imaging tests make pictures of the insides of your body. They can show which sites have leukemia. They can also show sites of infection or bleeding. Such health problems may impact your care.

Your treatment team will tell you how to prepare for these tests. You may need to stop taking some medicines. You may need to stop eating and drinking for a few hours before the scan. Tell your doctors if you get nervous when in small spaces. You may be given a pill to help you relax.

Some imaging tests use contrast. It is a dye that makes the pictures clearer. Tell your doctor if you've had problems with contrast in the past.

A radiologist is a doctor who's an expert in reading images. He or she will convey the test results to your doctor.

Brain CT

CT (**c**omputed **t**omography) takes many pictures of a body part using x-rays. A computer combines the x-rays to make one detailed picture. A CT of the brain is used to assess for bleeding. Contrast should not be used.

During the scan, you will need to lie face up on a table. The table will move through the machine. As the machine takes pictures, you may hear buzzing, clicking, or whirring sounds.

You will be alone in the room during the test. In a nearby room, the technician will operate the machine. He or she will be able to see, hear, and speak with you at all times. One scan is finished in about 30 seconds.

Brain MRI

MRI (**m**agnetic **r**esonance **i**maging) uses a magnetic field and radio waves to make pictures. It can show if the outer layer of the brain is swollen. Swelling caused by leukemia is called leukemic meningitis.

A device will be placed around your head that sends and receives radio waves. **See Figure 7**. Contrast should be used. It's important to lie still during the test. Straps may be used to help you stay in place.

You will be inside the machine during the scan. You can wear earplugs to block noise. Your head may feel a bit warm during the scan.

Figure 7
Brain MRI

MRI can show if the outer layer of the brain is swollen.

PET/CT

Sometimes CT is combined with PET (**p**ositron **e**mission **t**omography). This combined test is called a PET/CT scan. It may be done with one or two machines depending on the cancer center. It is used to detect leukemia in organs.

PET requires injecting a radiotracer into your bloodstream. Cancer cells absorb more radiotracer than normal cells. They appear brighter in pictures. PET can show even small amounts of cancer.

Spinal fluid tests

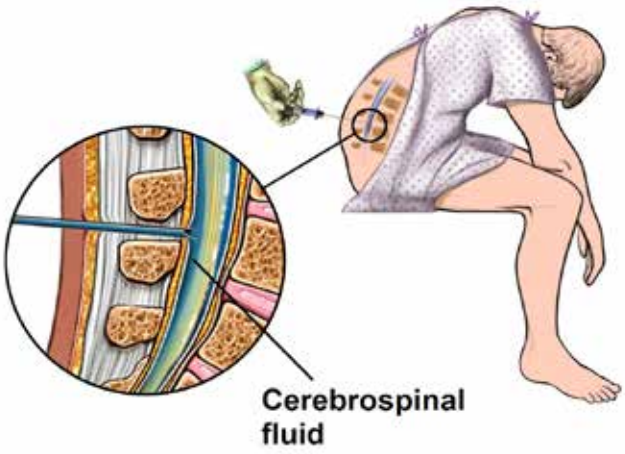
Leukemia cells in spinal fluid may or may not cause symptoms. To confirm their presence, a fluid sample must be removed and tested. A lumbar puncture is a procedure that removes spinal fluid. It is also called a spinal tap. A lumbar puncture may also be used to inject cancer drugs into spinal fluid.

During a spinal tap, you will be lying down or sitting on an exam table. If lying down, your knees must be tucked up near your chest. If sitting, you must lean forward toward your knees as shown in **Figure 8**.

The lower part of your back over your spine will be numbed. Next, a thin needle will be inserted between your spinal bones. You may feel some pressure. A fluid sample will be obtained and sent to a lab.

Figure 8
Lumbar puncture

A lumbar puncture is used to remove a sample of spinal fluid. The fluid will be tested for leukemia. A lumbar puncture may also be used to inject cancer drugs into spinal fluid.



Heart tests

Your doctor may test how well your heart pumps blood. Test results will be used to plan treatment. You may receive one of the two tests described next.

Echocardiogram

This test uses sound waves to make pictures. During the test, you will be lying down. Small patches will be placed on your chest to track your heartbeat. Next, a probe with gel on its tip will be slid across part of your bare chest. A picture of your beating heart will be seen on a screen. The pictures will be recorded for future viewing.

MUGA

A MUGA (**mu**lti-**g**ated **a**cquisition) scan also makes pictures of your heart. Patches will be placed on your chest to track your heartbeat. You will receive a shot of a radiotracer into your vein. Pictures of your heart will be taken with a special camera. The pictures will show the radiation that is released by the tracer.

Review

- Your doctor will ask you about any health problems and treatment in your lifetime.
- Your doctor will study your body to assess your health. He or she will touch parts of your body to see if anything feels abnormal.
- Blood tests will be done to look for signs of health problems. Blood clotting tests will also be done.
- A bone marrow aspiration and biopsy are procedures that remove bone and marrow samples.
- Your marrow will be tested for markers of leukemia cells.
- HLA typing is needed if you will receive a transplant of blood stem cells from a donor.
- Imaging tests may be given to look for sites of infection, bleeding, and leukemia.
- A spinal tap may be done to look for leukemia in spinal and brain fluid.
- A test of your heart may be done to assess what treatment you can receive.

“

Confidence in your treatment is key. Get a second opinion if you have doubts. Your doctors won’t be offended. Also, let your medical team know if you feel off. Remember that “the squeaky wheel gets the grease."

– Greg
Cancer survivor
Diagnosed at age 35

3
Treatment guide: APL AML

This chapter is a treatment guide for the APL subtype of AML. It starts with a brief overview of the treatment process. It also lists treatment options and explains supportive care. Your doctor may suggest other options based on your health and wishes. Fully discuss your options with your doctor.

Overview

APL (**a**cute **p**romyelocytic **l**eukemia) is a rare type of AML. About 10 out of every 100 people with AML have APL. Without treatment, APL can worsen quickly. With treatment, APL is cured more often than other AML types.

Diagnosis

The hallmark of APL is a translocation between chromosomes 15 and 17. This translocation is referred as t(15;17). It makes two fusion genes. These genes are called *PML-RARA* and *RARA-PML*. You will be treated for APL if the *PML-RARA* gene is present.

APL can cause bleeding that can be fatal. **Start taking retinoid (ATRA) right away if your doctor suspects APL.** It can stop the bleeding. If APL is not confirmed, stop taking the retinoid.

The cause of APL is very rarely known. It can occur for no known reason. Other times, it is caused by certain treatments of other cancers. Treatment for APL is not based on what caused it.

Treatment phases

Treatment for APL can occur over years. It involves several phases. These phases are briefly described next.

Induction

This is the first phase of treatment. The goal is to reduce the number of blasts. Results will be assessed after 4 to 6 weeks of treatment.

Induction often causes a large drop in the number of blasts. This is called a morphologic complete response. The hallmark—t(15;17)—is often absent at this time, too. This is called a cytogenetic complete response.

Once these responses are achieved, a molecular complete response will likely follow. This response is defined as the absence of the *PML-RARA* gene. Often, more treatment is needed to achieve a molecular response. The absence of all signs and symptoms of cancer is called a complete remission.

> “Before I was sick, I was a very active person. I'm not one to sit down. I had to adjust my life. I knew that I could find things that would make me happy and move on and get stronger.
>
> – Patsy
> Cancer survivor for 13 years

Bone marrow tests
Bone marrow samples are needed to assess induction results. Marrow tests should not occur sooner than 28 days after treatment starts. If the tests are done sooner, the *PML-RARA* gene may still be present.

Your doctor will look for blasts in the marrow. If absent, induction can be stopped to allow your marrow to make more blood cells. This is called recovery. If present, you may stay on treatment and repeat the marrow tests 1 week later.

Consolidation
Consolidation is the second phase of treatment. It treats blasts that may have survived induction. It can achieve a long-lasting molecular response.

Before induction, your white blood cell count may have been greater than 10,000 mcL. In this case, you may have a lumbar puncture before consolidation. Your spinal fluid will be tested for leukemia cells.

Some types of consolidation may be harmful to your heart. Before treatment, your doctor may test how well your heart is working. You may receive treatment for your heart, too.

Molecular testing
Bone marrow samples are needed to assess consolidation results. Marrow PCR can detect whether the *PML-RARA* gene is present or not. If it is, PCR will be done again within 4 weeks.

Maintenance and monitoring
Maintenance is the final phase of treatment. The goal is to prolong the good results of prior treatment. Which treatment you will receive is based on your prior treatment. Treatment may be received for 1 to 2 years.

Monitoring is a prolonged period of testing to assess treatment results. PCR every 3 months for 2 years is advised. PCR is described in Part 2. Bone marrow or blood samples may be used.

Relapse
Some people have a relapse after molecular response. The goal of treatment is to achieve remission again. You may receive treatment to prevent APL from spreading to your brain and spine.

“

My daily lifeline were my nurses! Their professionalism, compassion, and care got me through the most difficult days. When I visit the clinic for yearly checkups, they still remember me and tears of joy flow from my heart.

– Patricia
Cancer survivor
Diagnosed at age 51

Treatment options

Not all people with APL receive the same treatment. Treatment options are based on many factors. One of these factors is the risk for poor outcomes like fatal bleeding.

Doctors plan treatment for APL using risk groups. These risk groups are based on the white blood cell count at diagnosis. The low-risk group is defined by a count of 10,000 mcL or less. The high-risk group is based on a count greater than 10,000 mcL.

Guide 2 lists treatment options for the low-risk group. On page 26, Guides 3 and 4 present treatment options for the high-risk group. On page 27, Guide 5 lists options for relapse.

Some treatments are the same for both risk groups. However, the dose or schedule of these treatments may differ. Ask your doctor for the details of your treatment. What is the dose? How often is treatment received? How many treatment cycles are needed?

To achieve the best results, follow the treatment schedule your doctor gives you. Do not switch to a new regimen for consolidation.

ATRA

For both risk groups, all options include ATRA (**a**ll-**t**rans **r**etinoic **a**cid). This drug is also called a retinoid. It is mostly known as a treatment for acne. However, it also treats some types of cancer. Retinoid forces APL blasts to mature and become normal cells.

Retinoid is a good treatment for APL. It alone can achieve a complete response in most people. However, this response is short-lived. Other treatments must be used to achieve better results.

Retinoid is made in pill form. The daily dose is 45 mg/m^2. Children and teenagers may take a lower dose of 25 mg/m^2.

Guide 2. Treatment for low-risk group

Preferred options

Induction		Consolidation
• ATRA + arsenic trioxide	→	• ATRA + arsenic trioxide

Other options

Induction		Consolidation
• ATRA + idarubicin	→	• ATRA + idarubicin, then • ATRA + mitoxantrone, then • ATRA + idarubicin
• ATRA + higher-dose arsenic trioxide	→	• ATRA + high-dose arsenic trioxide

Guide 3. Treatment for high-risk group with no heart issues

Preferred options

Induction		Consolidation
• ATRA + idarubicin + arsenic trioxide	→	• ATRA + arsenic trioxide
• ATRA + arsenic trioxide + gemtuzumab	→	• ATRA + arsenic trioxide or • Gemtuzumab
• ATRA + high-dose arsenic trioxide + gemtuzumab	→	• ATRA + high-dose arsenic trioxide or • Gemtuzumab

Other options

Induction		Consolidation
• ATRA + daunorubicin + cytarabine	→	• Arsenic trioxide, then • ATRA + daunorubicin
• ATRA + high-dose daunorubicin + cytarabine	→	• High-dose daunorubicin + cytarabine, then • Cytarabine + daunorubin + intrathecal chemotherapy
• ATRA + idarubicin	→	• ATRA + idarubicin and cytarbine, then • ATRA + mitoxantrone, then • ATRA + idarubicin + cytarabine

Guide 4. Treatment for high-risk group with heart issues

Induction		Consolidation
• ATRA + arsenic trioxide + gemtuzumab	→	• ATRA + arsenic trioxide or • Gemtuzumab
• ATRA + high-dose arsenic trioxide + gemtuzumab	→	• ATRA + high-dose arsenic trioxide or • Gemtuzumab
• ATRA + gemtuzumab	→	• ATRA + gemtuzumab

Guide 5. Treatment for relapse

Time of relapse	Prior treatment	What are the options?
• Less than 6 months since prior treatment	• ATRA + arsenic trioxide	• Anthracycline-based regimen in Guide 3
	• ATRA + (idarubicin or daunorubicin)	• ATRA + arsenic trioxide ± gemtuzumab
• 6 months or more since prior treatment	• ATRA + arsenic trioxide	• ATRA + gemtuzumab
• Any time	• Have not taken arsenic trioxide	• ATRA + arsenic trioxide ± gemtuzumab

Arsenic trioxide

Arsenic **t**rioxide (or ATO) causes the death of APL cells. When added to ATRA, it improves outcomes. More leukemia cells die. Relapse occurs in fewer people.

Arsenic is sold as Trisenox®. It is slowly injected into a vein with a needle. The standard dose is 0.15 mg/kg. However, higher doses given less often are sometimes an option. Sometimes, arsenic is given every day. Other times, it is given on some days during a treatment cycle.

Chemotherapy

Chemotherapy, or "chemo," includes drugs that disrupt the life cycle of cancer cells. Thus, the cancer cells don't increase in number. The types of chemotherapy differ in the way they work.

Anthracyclines damage and disrupt the making of DNA. These drugs include daunorubicin (Cerubidine®) and idarubicin (Idamycin PFS®). ATRA with idarubicin is called AIDA.

Antimetabolites prevent the "building blocks" of DNA from being used. These drugs include cytarabine (Cytosar-U®). Cytarabine is sometimes given with ATRA and an anthracycline.

Most research has studied the effects of ATRA with anthracyclines. A complete response is achieved in most people after induction. After consolidation, most people have a molecular response.

Chemotherapy is most often slowly injected into a vein with a needle. Intrathecal chemotherapy is injected into spinal or brain fluid. Chemotherapy is given in cycles of treatment days followed by days of rest. The dose differs between people.

Gemtuzumab

Gemtuzumab **o**zogamicin (or GO) is a type of targeted therapy. It attaches to a cell surface protein called CD33 then enters the cell. Once inside, chemotherapy is released. Many blasts have CD33 proteins. Mature blood cells do not have CD33 and are not affected.

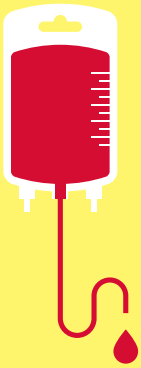
Gemtuzumab is sold as Mylotarg™. It is slowly injected into a vein with a needle. The dose is not the same for everyone. Gemtuzumab is given in cycles of treatment days followed by days of rest.

Blood stem cell transplant

This treatment is also called a HCT (**h**ematopoietic **c**ell **t**ransplant). It replaces damaged or destroyed stem cells with healthy stem cells. The healthy stem cells form new marrow and blood cells. A transplant is sometimes an option after relapse treatment.

An autologous transplant may be an option after a second molecular response. This treatment is also called HDT/ASCR (**h**igh-**d**ose **t**herapy with **a**utologous **s**tem **c**ell **r**escue). First, your healthy stem cells will be removed. You will then receive treatment to kill your marrow cells. Your healthy stem cells will be returned to "rescue" your marrow.

An allogeneic transplant uses healthy stem cells from a donor. It may be an option if less than a molecular response is achieved. You'll first receive treatment to kill your bone marrow cells. Next, you'll receive the donor cells. These cells will form new, healthy marrow. They will also attack blasts that weren't killed by prior treatment.



Learn more about transplants

Visit the websites listed in Part 5 for more information on blood stem cell transplants.

Clinical trial

A clinical trial is a type of research that studies a test or treatment in people. It gives people access to health care that otherwise can't usually be received. Ask your treatment team if there is an open clinical trial that you can join. It may be an option for any phase of treatment.

"I was accepted into a study and I was hopeful and confident I would beat my disease."

– Kelly
Cancer Survivor
Diagnosed at age 47

Supportive care

Supportive care aims to improve your quality of life. It includes care for health issues caused by cancer or cancer treatment. It is sometimes called palliative care.

All cancer treatments can cause unwanted health issues. Such health issues are called side effects. Side effects depend on many factors. These factors include the drug type and dose, length of treatment, and the person. Some side effects may be harmful to your health. Others may just be unpleasant.

Ask your treatment team for a complete list of side effects of your treatments. Also, tell your treatment team about any new or worse symptoms you get. There may be ways to help you feel better. There are also ways to prevent some side effects. Next, supportive care for some key health problems are described.

Bleeding

APL can cause bleeding that can be fatal. Thus, your blood will be tested to see how well it clots. Delay health care that may cause bleeding until your blood clots well.

Bleeding can be managed. Platelet transfusions can maintain the platelet count at 50,000 mcL or higher. The normal range is 150,000 to 450,000 mcL.

Fibrinogen is needed for blood clots to form. Its normal range is 150 to 400 mg/dL. A normal level can be achieved with cryoprecipitate and fresh frozen plasma. Cryoprecipitate is a product from thawed frozen blood.

Differentiation syndrome

A syndrome is a group of health symptoms or signs. Together, they suggest the presence of or risk for a disease. Differentiation syndrome occurs among people treated for APL. It used to be called retinoic acid syndrome.

Symptoms of differentiation syndrome include fever, swelling in limbs, and trouble breathing. You can also gain weight and get a skin rash. Signs include low blood pressure and a drop in blood oxygen. Fluid can build up around your lungs or heart. Damage to your kidneys and liver may occur. This syndrome can be fatal.

Differentiation syndrome is most often caused by ATRA or arsenic trioxide. It occurs in about 15 out of every 100 people during their first treatment. It also occurs during relapse treatment but not during consolidation or maintenance. Less often, differentiation syndrome starts before any treatment. Other types of treatment can also trigger it.

Tests

You will be assessed for differentiation syndrome throughout treatment. Your doctor will ask about any new or worse symptoms. Your blood cell counts will be measured. You may receive scans to assess the cause of a cough or trouble breathing.

Prevention

Not every person gets differentiation syndrome. A white blood count higher than 10,000 mcL puts you at risk. Your doctor may prescribe steroids to try to prevent it. In this case, prednisone or dexamethasone is advised.

Treatment

At the first signs or symptoms, start dexamethasone right away. It can help your blood count return to normal. Your doctor may stop ATRA or arsenic until your health is stable.

If dexamethasone doesn't work, chemotherapy may help. Anthracycline is one option. Another is an antimetabolite called hydroxyurea.

Fast heartbeat

Arsenic trioxide can cause your heart to beat too fast. Specifically, the lower chambers of your heart may beat too fast. This is called ventricular arrhythmia.

Your heart will be tested before induction. Your electrolytes will also be measured. Your doctor may reduce or stop medications that increase your heartbeat. You may also be given electrolytes to correct levels.

Review

- With treatment, APL is cured more often than other AML types.
- Start taking retinoid right away if your doctor suspects APL. It may stop fatal bleeding.
- Treatment for APL involves several phases.
- Doctors plan treatment for APL using low- and high-risk groups. ATRA-based treatment is advised for both risk groups.
- Supportive care can help to prevent death from health issues caused by APL or its treatment.

“

Treatment was long and grueling, with good days and bad days. My focus was to get home. I know now that people are most important. Objects are nothing. And when you can’t fight anymore, you fight harder because you are strong.

– Amy
Cancer survivor
Diagnosed at age 42

4

Treatment guide: Non-APL AML

This chapter is a treatment guide for all non-APL subtypes of AML. It starts with a brief overview of the treatment process. It also lists treatment options and explains supportive care. Your doctor may suggest other options based on your health and wishes. Fully discuss your options with your doctor.

Overview

There are many subtypes of AML. Most people with leukemia do not have APL. In the past, all non-APL subtypes were treated the same way. As doctors learn more, treatment is being improved to better target each subtype.

Diagnosis

Acute leukemia is defined by a high number of blasts in the bone marrow or blood. The standard cutoff is at least 20 out of every 100 marrow cells are blasts. If there are fewer blasts, then a common marker must be present. Subtypes of AML are based on features of the cells.

The cause of AML is not always known. It can occur for no known reason. Other times, it is caused by certain treatments of other cancers. AML can also arise from MDS (**m**yelo**d**ysplastic **s**yndromes). Treatment for AML is not based on what caused it.

Treatment phases

Treatment for AML can occur over years. It involves several phases. These phases are briefly described next.

Induction

This is the first phase of treatment. It is also called remission induction. It is standard to receive 2 to 4 chemotherapy drugs for 3 to 10 days.

The treatment goal is to greatly reduce the number of blasts. As the blasts decrease, other types of marrow cells will decrease, too. The other treatment goal is to restore the process of making normal blood cells.

Monitoring

Blood samples will be needed often to check treatment results. Your blood counts will be measured. The health of organs like your liver and kidneys will also be assessed.

Bone marrow samples will also be obtained. This typically occurs 2 to 3 weeks after the start of chemotherapy. Samples may be obtained 3 to 4 months after some low-intensity treatments. Marrow tests will show how well treatment worked. If too many blasts are present, marrow tests may be repeated.

If the blasts persist, you may receive more treatment. This extra treatment is sometimes called re-induction. After more induction, the blasts may persist. In this case, treatment options will include those for relapse. These options are described below.

If blasts are absent in marrow, no treatment will be given for 2 to 4 week. During this time, your marrow will begin to make normal blood cells again. This is called recovery.

When blood counts become normal, marrow tests will be done again. Your doctor will check if the leukemia is in remission. A complete remission is an absence of all signs and symptoms.

Consolidation

This is the second phase of treatment. It is also called post-remission therapy. It treats blasts that may have survived induction.

You may receive the same drugs used for induction. If not, you may receive one drug at a higher dose. A blood stem cell transplant may also be an option. It

is sometimes done if the leukemia is likely to return after treatment.

You may have a lumbar puncture before consolidation. The removed spinal fluid will be tested for blasts. Your doctor may order this test based on your pre-treatment white blood count, leukemia subtype, and other factors.

Some types of consolidation may be harmful to your heart. Before treatment, your doctor may test how well your heart is working. You may receive treatment for your heart, too.

Maintenance
For some people, maintenance is the final phase of treatment. The goal is to prolong the good results of prior treatment. Treatment may be received for years.

Surveillance
Surveillance is a period of testing that is started after consolidation. A CBC every 1 to 3 months for 2 years is advised. Then, it should then be repeated every 3 to 6 months for 3 more years. If results aren't normal, bone marrow tests may be needed.

Relapse
For some people, the leukemia may return. This is called a relapse. The goal of treatment is to achieve remission again. You may receive treatment to prevent the blasts from spreading to your brain and spine.

Bone marrow biopsies are not fun. I was glad when I hit 5 years and didn't need to do them again. I see my oncologist once a year now. She's been with me for 15 years and we are glad to celebrate my good health together.

– Rhonda
Cancer survivor
Diagnosed at age 29

Treatment options

The behavior of AML often differs between older and younger people. Older people also often have more health problems. Thus, treatment is based on age as well as other factors. Other factors include your overall health and the phase of treatment.

Based on research, age 60 is used as the cutoff point for treatment options. On pages 36–37, Guides 6 through 8 list options for people 60 years of age and younger. On pages 38–39, Guides 9 through 11 list options for older people. The treatments listed are briefly described in this section.

Ask your doctor the details of your treatment. What is the dose? How often is treatment received? How many treatment cycles are needed?

Clinical trial

A clinical trial is a type of research that studies a test or treatment in people. It gives people access to health care that otherwise can't usually be received. Ask your treatment team if there is an open clinical trial that you can join. It may be an option at any phase of treatment.

Join a clinical trial

Talk to your doctor about joining a clinical trial. It may be an option at any phase of treatment.

Chemotherapy

Chemotherapy, or "chemo," includes drugs that disrupt the life cycle of cancer cells. Thus, the cancer cells don't increase in number. Chemotherapy also kills some normal cells, too. The types of chemotherapy differ in the way they work.

Cytarabine

Antimetabolites prevent the "building blocks" of DNA from being used. Cytarabine is an antimetabolite. It is included in the most common regimens.

Cytarabine is sold as Cytosar-U®. It is most often given as a 24-hour injection over 7 days. The standard dose is 100–200 mg/m^2. A mid dose ranges from 1 g/m^2 to just under 2 g/m^2. A high dose is 2 g/m^2 or more. High doses may be an option if you are younger than 60 years.

A low dose of cytarabine is sometimes used. It may be an option if you are older and frail. A low dose of 20 mg can be injected under the skin. It may take 3 to 4 months to see results.

Cytarabine can treat blasts in the lining of the spine or brain. In this case, it is injected into the spinal fluid.

Cladribine and fludarabine

These drugs are also antimetabolites. They are part of some cytarabine-based regimens. These regimens may be an option for induction among people younger than 60 years. They may also be an option if induction didn't work or the leukemia relapsed.

Cladribine is sold as Leustatin®. Fludarabine is sold as Fludara®. Both are given as a slow injection into a vein. They are given in cycles of treatment days followed by days of rest.

Methotrexate

Methotrexate is an antimetabolite. It can treat blasts in the lining of the spine or brain. It is injected into the spinal fluid.

Daunorubicin, idarubicin, and mitoxantrone
These drugs are anthracyclines. Anthracyclines damage and disrupt the making of DNA. They are used with other drugs for treatment.

These drugs can cause heart problems. They may not be an option for you. The dose given depends on multiple factors. There is a limit to how much you can receive in your lifetime.

The "7+3 regimen" has been a standard of care for decades. This treatment consists of 7 days of cytarabine and 3 days of daunorubicin or idarubicin. It is used for induction.

Daunorubicin is sold as Cerubidine®. It is slowly injected into a vein. Depending on the dose, it may take minutes or hours to receive. It is given for 3 days within a treatment cycle.

Idarubicin is sold as Idamycin PFS®. It is slowly injected into a vein over 10 to 15 minutes. It is given for 3 days within a treatment cycle.

Mitoxantrone is sold as Novantrone®. It is slowly injected into a vein in about 30 minutes. The number of treatment days within a cycle varies based on the regimen.

Cytarabine and daunorubicin liposome
This dual-drug treatment is packed inside a case called a liposome. The liposome enters and stays within the bone marrow. Next, it enters leukemia cells more so than normal cells. Once inside the cells, the drugs are released.

Cytarabine and daunorubicin liposome may be better than standard chemotherapy in certain cases. You must have AML related to either prior treatment or MDS. If younger than 60 years, you must not have CBF (**c**ore **b**inding **f**actor) AML. If you're 60 years of age or older, the leukemia cells must have high-risk markers.

Cytarabine and daunorubicin liposome is sold as Vyxeos™. It is slowly injected into a vein over 90 minutes. It is given in cycles of treatment days followed by days of rest. For induction, you will likely be in the hospital for part or all of the cycle.

Etoposide
Topoisomerase is a protein that unknots or unwinds DNA. There are two types of this protein. Etoposide phosphate stops type II from working. This leads to DNA damage and cell death.

Etoposide may also be an option for induction if you have heart problems. It may be used instead of anthracyclines in cytarabine-based treatment.

It may also be an option if induction didn't work or the leukemia relapsed. It is given with cytarabine. Mitoxantrone may be added.

Etoposide is sold as Etopophos®. It is slowly injected into a vein in about an hour. It is given in cycles of treatment days followed by days of rest.

"

My initial induction did not produce the desired result. I had to go through a second induction. I was afraid I might not make it through. If not for my wife and her loving insistence, I may not have done it.

– Bob
Cancer survivor
Diagnosed at age 54

60 years of age and younger

Guide 6. Induction

Standard-dose cytarabine

What are the options?	Induction results	What are the next options?
• Cytarabine + (idarubicin or daunorubicin) • Cytarabine + daunorubicin + cladribine • Cytarabine + daunorubicin + midostaurin for FLT3+ AML • Cytarabine and daunorubicin liposome for treatment- or MDS-related AML • Cytarabine + daunorubicin + gemtuzumab for CD33+ AML	High blast count	• Mid- to high-dose cytarabine • Cytarabine + (idarubicin or daunorubicin) • Cytarabine + daunorubicin + midostaurin for FLT3+ AML • Cytarabine and daunorubicin liposome
	Low blast count	• Cytarabine + (idarubicin or daunorubicin) • Cytarabine + daunorubicin + midostaurin for FLT3+ AML
	Blasts are not clearly present	• Wait for blood cell counts to return to normal

High-dose cytarabine

What are the options?
• Cytarabine + (idarubicin or daunorubicin)
• Cytarabine + fludarabine + idarubicin + growth factors

Guide 7. Consolidation

Chance for relapse	What are the options?
Low	• High-dose cytarabine
	• High-dose cytarabine + daunorubicin + gemtuzumab for CD33+ AML
Moderate	• Blood stem cell transplant
	• Mid- to high-dose cytarabine
	• Mid- to high-dose cytarabine + midostaurin for FLT3+ AML
	• High-dose cytarabine + daunorubicin + gemtuzumab for CD33+ AML
High	• Blood stem cell transplant
	• Mid- to high-dose cytarabine
	• Mid- to high-dose cytarabine + midostaurin for FLT3+ AML
	• Cytarabine and daunorubicin liposome for treatment- or MDS-related AML

Guide 8. Treatment for relapse

Time of relapse	What are the options?
• Less than 12 months since prior treatment	• Clinical trial then blood stem cell transplant if you're able
	• Chemotherapy not received before then blood stem cell transplant if you're able
• 12 or more months sincer prior treatment	• Clinical trial then blood stem cell transplant if you're able
	• Chemotherapy then blood stem cell transplant if you're able
	• Repeat induction then blood stem cell transplant if you're able

61 years of age and older

Guide 9. Induction

High-intensity treatments

What are the options?	Induction results	What are the next options?
• Cytarabine + (idarubicin or daunorubicin or mitoxantrone) • Cytarabine + daunorubicin + midostaurin for FLT3+ AML • Cytarabine + daunorubicin + gemtuzumab for CD33+ AML • Cytarabine and daunorubicin liposome for treatment- or MDS-related AML	Blasts are present	• Cytarabine + (idarubicin or daunorubicin or mitoxantrone) • Cytarabine + daunorubicin + midostaurin for FLT3+ AML • Cytarabine and daunorubicin liposome for treatment- or MDS-related AML • Mid-dose cytarabine-based treatment • Blood stem cell transplant • Wait for blood counts to return to normal • Best supportive care
	Blasts are not clearly present	• Wait for blood counts to return to normal

Low-intensity treatment

What are the options?	Induction results	What are the next options?
• Decitabine or 5-azacytidine or low-dose cytarabine • Gemtuzumab for CD33+ AML • Enasidenib for IDH2+ AML • Best supportive care	Decrease in blast count	• Reduced-intensity transplant • Stay on decitabine or 5-azacytidine • Gemtuzumab for CD33+ AML • Stay on enasidenib
	Same or higher blast count	• Best supportive care

Guide 10. Consolidation after high-intensity treatment

What are the options?
• Reduced-intensity blood stem cell transplant
• Cytarabine ± (idarubicin or daunorubicin)
• Mid-dose cytarabine + midostaurin for FLT3+ AML
• Cytarabine and daunorubicin liposome for treatment- or MDS-related AML
• High-dose cytarabine + daunorubicin + gemtuzumab for CD33+ AML
• Maintenance therapy with decitabine or 5-azacytidine
• Watch and wait

Guide 11. Treatment for relapse

Time of relapse	What are the options?
• Less than 12 months since prior treatment	• Clinical trial then blood stem cell transplant if you're able
	• Best supportive care
	• Chemotherapy then blood stem cell transplant if you're able
• 12 or more months sincer prior treatment	• Clinical trial then blood stem cell transplant if you're able
	• Repeat induction then blood stem cell transplant if you're able
	• Chemotherapy then blood stem cell transplant if you're able
	• Best supportive care

Decitabine and 5-azacytidine
Methyl is a chemical that is added to DNA. It can turn genes on or off. Leukemia cells often have too many methyl groups. These extra groups can block genes from being turned on and off.

Hypomethylating agents block methyl from binding to DNA. Decitabine and 5-azacytidine are two such agents. They turn silenced genes back on, which allows blasts to mature.

Hypomethylating agents may be a good option for induction if you are older or are quite sick. They also work well against leukemia cells with high-risk markers. It may take 3 to 4 months to see results. These agents are also sometimes used for maintenance.

5-azacytidine is sold as Vidaza®. It can be injected under the skin in a few minutes. It can also be slowly injected into a vein in under one hour. It is given in cycles of treatment days followed by days of rest.

Decitabine is sold as Dacogen®. It is slowly injected into a vein in about an hour. It is given in cycles of treatment days followed by days of rest.

Targeted therapy

Targeted therapy is a class of drugs. Most often, it works by stopping molecules that help cancer cells grow. It is less likely to harm normal cells than chemotherapy.

Gemtuzumab
Many leukemia blasts have CD33 proteins. This protein resides on the cell surface. **G**emtuzumab **o**zogamicin (or GO) binds to CD33 then enters the cell. Once inside, chemotherapy is released. Mature blood cells do not have CD33 and are not affected.

Gemtuzumab is an option for many phases of treatment. It may be used with chemotherapy. It is also sometimes used alone. When used with chemotherapy, it may improve results for CBF AML.

Gemtuzumab is sold as Mylotarg™. It is slowly injected into a vein with a needle. The dose is not the same for everyone. Gemtuzumab is given in cycles of treatment days followed by days of rest.

Enasidenib
Some people have blasts with an abnormal cell protein called IDH2. This protein causes young blood cells to become leukemia cells instead of mature cells. Enasidenib allows the young blood cells to mature. It may take 3 to 5 months to see results.

Enasidenib is an option in certain cases. IDH2 must be abnormal. Induction may consist of enasidenib only instead of standard-dose cytarabine. Enasidenib may also be an option when cytarabine doesn't work or the leukemia relapsed.

Enasidenib is sold as Idhifa®. It is a pill taken one time a day. Take it at the same time every day.

Midostaurin and sorafenib
Some people have blasts with an abnormal cell protein called FLT3. This protein helps cell growth. Midostaurin and sorafenib block the action of FLT3 as well as other proteins. As a result, cells with abnormal FLT3 stop growing and die.

Midostaurin and sorafenib are options in certain cases. FLT3 must be abnormal. Midostaurin with chemotherapy may be an option for many phases of treatment. Sorafinib with a hypomethylating agent may be an option if induction didn't work or the leukemia relapsed.

Midostaurin is sold as Rydapt®. It is a pill taken twice a day. It must be taken with food.

Sorafenib is sold as Nexavar®. The standard dose is two pills taken twice a day. Do not take the pills with food.

Blood stem cell transplant

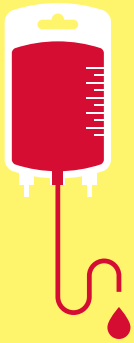
This treatment is also called an HCT (**h**ematopoietic **c**ell **t**ransplant). It replaces damaged or destroyed stem cells with healthy stem cells. An allogeneic transplant uses healthy stem cells from a donor. The donor may or may not be related to you.

A donor transplant is not used for induction. It is an option for consolidation. It is also sometimes used to treat a relapse.

Before the transplant, you will receive treatment that destroys bone marrow cells. The death of these cells creates room for the donor cells. It also weakens your immune system so your body won't kill the donor cells.

Treatment before the transplant may consist of multiple chemotherapy drugs. Sometimes, it consists of chemotherapy with radiation therapy. Reduced-intensity treatment consists of low doses of strong chemotherapy or low-intensity drugs.

After your bone marrow cells are destroyed, you'll receive the donor cells. These cells will form new marrow with healthy cells. They will also attack blasts that weren't killed by prior treatment.



Learn more about transplants

Visit the websites listed in Part 5 for more information on blood stem cell transplants.

"My biggest shock came when I was told that I had about 9 months to live or undergo a bone marrow transplant. Six years later, I have a great life with a wonderful support team of my husband, friends, and a terrific doctor and her entire team.

– Rima
Cancer survivor

Supportive care

Supportive care aims to improve your quality of life. It includes care for health issues caused by cancer or cancer treatment. It is sometimes called palliative care.

All cancer treatments can cause unwanted health issues. Such health issues are called side effects. Side effects depend on many factors. These factors include the drug type and dose, length of treatment, and the person. Some side effects may be harmful to your health. Others may just be unpleasant.

Ask your treatment team for a complete list of side effects of your treatments. Also, tell your treatment team about any new or worse symptoms you get. There may be ways to help you feel better. There are also ways to prevent some side effects. Next, supportive care for some key health problems are described.

Abnormal blood cells counts

Before treatment, your white blood cell count may be very high. A high count can cause severe health problems. Apheresis or hydroxyurea can quickly reduce the count. Apheresis is a procedure that can remove certain types of cells from your blood. Hydroxyurea is a drug.

During chemotherapy, you may need blood transfusions. Most white blood cells should be removed from donor blood. Donor blood should also be treated with radiation if your treatment will suppress your immune system. These steps will help prevent donor blood from attacking your body. They will also help prevent infections.

Growth factors trigger the bone marrow to make blood cells. They are sometimes part of a chemotherapy regimen. They are an option for supportive care during consolidation if you have a life-threatening infection.

Eye problems

High-dose cytarabine can cause eye problems. The white of your eyes may become red. Your eyes may feel painful and make more tears. These problems may be prevented with saline or steroid eye drops. Drops will be given 4 times a day until treatment is done.

Brain impairment

Cytarabine can affect the part of the brain that coordinates movement. Symptoms include constant eye movement that can't be controlled. You may be unable to control the range of movement by your legs or arms. Your speech may become slurred.

High-dose cytarabine can cause these problems in people of any age. Mid-dose cytarabine increases the chance among people older than 60 years of age. With either dose, your risk of these problems rises if your kidneys don't work well.

You will be assessed for brain problems before each dose of cytarabine. If problems are present, cytarabine should be stopped. The problems will end within days or weeks after cytarabine is stopped. Don't get the same dose of cytarabine in the future.

Infections

You are at risk for infections. If not treated early, infections can be fatal. Infections can be caused by viruses, fungus, or bacteria. Antibiotics can treat fungal and bacterial infections. You may be given antiviral drugs to prevent viral infections.

Tumor lysis syndrome

TLS (**t**umor **l**ysis **s**yndrome) occurs when the waste released by dead cells is not quickly cleared out of your body. This results in kidney damage and severe blood electrolyte disturbances. It can be life threatening.

Induction chemotherapy may cause TLS. Many cells are killed during induction. This results in too much

waste too quickly. TLS is more likely if your blast count is very high.

Allopurinol or rasburicase are drugs that decrease uric acid levels. Rasburicase may be given first if your blast count is quickly rising. It may also be first received if your uric acid level is high or your kidneys are damaged.

Staying hydrated can help. Drinking lots of water can help flush out cell waste. If your blast count is very high, you may need to get fluids at a hospital. These fluids will be injected into a vein.

Differentiation syndrome

Differentiation syndrome may occur among people taking enasidenib. It used to be called retinoic acid syndrome. Its symptoms include fever, swelling in limbs, and trouble breathing. You can also gain weight and get a skin rash.

Signs include low blood pressure and a drop in blood oxygen. Fluid can build up around your lungs or heart. Damage to your kidneys and liver may occur.

Treatment must be started at the first signs or symptoms. A steroid is one option for treatment. Another is an antimetabolite called hydroxyurea.

I was through 7 + 3 treatment before I even fully understood my disease, its prognosis, or my long-term treatment options. I spent the next four weeks in the hospital for infection management and count recovery before being discharged with a clean biopsy. I explored my options and had one round of consolidation chemo to keep me in remission until a double cord blood transplant. I remain cancer-free 17 months after my transplant.

– Steve
Cancer survivor
Diagnosed at age 64

Review

- Most people with AML have a subtype other than APL.
- Treatment for AML involves several phases.
- Your doctor will plan treatment based on your age and other factors. Chemotherapy is a key part of treatment. Targeted therapy may be added if certain cell markers are present.
- Supportive care can help to prevent or relieve health problems caused by AML or its treatment.

The treatment was tough due to nausea, vomiting, anorexia, and weakness. I was determined to stay positive and assured my family I would fight hard—and I did. It was important to try and eat, drink water and exercise every day—this I did.

– Gillian
Cancer survivor

5
Making treatment decisions

Having cancer is very stressful. While absorbing the fact that you have cancer, you have to learn about tests and treatments. In addition, the time you have to accept a treatment plan feels short. Parts 1 through 4 described AML and treatment options. This chapter aims to help you make decisions that are in line with your beliefs, wishes, and values.

It's your choice

The role patients want in choosing their treatment differs. You may feel uneasy about making treatment decisions. This may be due to a high level of stress. It may be hard to hear or know what others are saying. Stress, pain, and drugs can limit your ability to make good decisions. You may feel uneasy because you don't know much about cancer. You've never heard the words used to describe cancer, tests, or treatments. Likewise, you may think that your judgment isn't any better than your doctors'.

Letting others decide which option is best may make you feel more at ease. But, whom do you want to make the decisions? You may rely on your doctors alone to make the right decisions. However, your doctors may not tell you which to choose if you have multiple good options. You can also have loved ones help. They can gather information, speak on your behalf, and share in decision-making with your doctors. Even if others decide which treatment you will receive, you still have to agree by signing a consent form.

On the other hand, you may want to take the lead or share in decision-making. Most patients do. In shared decision-making, you and your doctors share information, weigh the options, and agree on a treatment plan. Your doctors know the science behind your plan but you know your concerns and goals. By working together, you are likely to get a higher quality of care and be more satisfied. You'll likely get the treatment you want, at the place you want, and by the doctors you want.

Questions to ask

You may meet with experts from different fields of medicine. Strive to have helpful talks with each person. Prepare questions before your visit and ask questions if the person isn't clear. You can also record your talks and get copies of your medical records.

It may be helpful to have your spouse, partner, or a friend with you at these visits. A patient advocate or navigator might also be able to come. They can help to ask questions and remember what was said. Suggested questions to ask are listed on the following pages.

"People want to help and don't know how. When offered help, we decline their offer. My suggestion is to have a list of things needed or desired. It's surprising how good it makes others feel to help out.

– Juanita
Cancer survivor for 22 years

What's my diagnosis and prognosis?

It's important to know that there are different types of cancer. Cancer can greatly differ even when people have a tumor in the same organ. Based on your test results, your doctors can tell you which type of cancer you have. He or she can also give a prognosis. A prognosis is a prediction of the pattern and outcome of a disease. Knowing the prognosis may affect what you decide about treatment.

1. Where did the cancer start? In what type of cell? Is this cancer common?
2. Is this a fast- or slow-growing blood cancer?
3. What tests do you recommend for me?
4. Where will the tests take place? How long will the tests take and will any test hurt?
5. What if I am pregnant?
6. How do I prepare for testing?
7. Should I bring a list of my medications?
8. Should I bring someone with me?
9. How often are these tests wrong?
10. Would you give me a copy of the pathology report and other test results?
11. Who will talk with me about the next steps? When?

What are my options?

There is no single treatment practice that is best for all patients. There is often more than one treatment option along with clinical trial options. Your doctor will review your test results and recommend treatment options.

1. What will happen if I do nothing?
2. Can I just carefully monitor the cancer?
3. Do you consult NCCN recommendations when considering options?
4. Are you suggesting options other than what NCCN recommends? If yes, why?
5. Do your suggested options include clinical trials? Please explain why.
6. How do my age, health, and other factors affect my options? What if I am pregnant?
7. Which option is proven to work best?
8. Which options lack scientific proof?
9. What are the benefits of each option? Does any option offer a cure or long-term cancer control? Are my chances any better for one option than another? Less time-consuming? Less expensive?
10. What are the risks of each option? What are possible complications? What are the rare and common side effects? Short-lived and long-lasting side effects? Serious or mild side effects? Other risks?
11. How do you know if treatment is working?
12. What are my options if my treatment stops working?
13. What can be done to prevent or relieve the side effects of treatment?

What does each option require of me?

Many patients consider how each option will practically affect their lives. This information may be important because you have family, jobs, and other duties to take care of. You also may be concerned about getting the help you need. If you have more than one option, choosing the option that is the least taxing may be important to you:

1. Will I have to go to the hospital or elsewhere? How often? How long is each visit?
2. What do I need to think about if I will travel for treatment?
3. Do I have a choice of when to begin treatment? Can I choose the days and times of treatment?
4. How do I prepare for treatment? Do I have to stop taking any of my medicines? Are there foods I will have to avoid?
5. Should I bring someone with me when I get treated?
6. Will the treatment hurt?
7. How much will the treatment cost me? What does my insurance cover?
8. Will I miss work or school? Will I be able to drive?
9. Is home care after treatment needed? If yes, what type?
10. How soon will I be able to manage my own health?
11. When will I be able to return to my normal activities?

What is your experience?

More and more research is finding that patients treated by more experienced doctors have better results. AML is not a common cancer so even experienced doctors don't treat AML often. It is important to learn if a doctor is an expert in the cancer treatment he or she is offering. Doctors who are not experts in a certain cancer can consult with doctors who are experts.

1. Are you board certified? If yes, in what area?
2. How many patients like me have you treated?
3. Will you be consulting with AML experts to discuss my health care? Who will you consult?
4. How many procedures like the one you're suggesting have you done?
5. Is this treatment a major part of your practice?
6. How many of your patients have had complications?

Deciding between options

Deciding which option is best can be hard. Doctors from different fields of medicine may have different opinions on which option is best for you. This can be very confusing. Your spouse or partner may disagree with which option you want. This can be stressful. In some cases, one option hasn't been shown to work better than another. Some ways to decide on treatment are discussed next.

2nd opinion

The time around a cancer diagnosis is very stressful. People with cancer often want to get treated as soon as possible. They want to make their cancer go away before it spreads farther. While cancer can't be ignored, there is time to think about and choose which option is best for you.

You may wish to have another doctor review your test results and suggest a treatment plan. This is called getting a 2nd opinion. You may completely trust your doctor, but a 2nd opinion on which option is best can help.

Copies of the pathology report, a DVD of the imaging tests, and other test results need to be sent to the doctor giving the 2nd opinion. Some people feel uneasy asking for copies from their doctors. However, a 2nd opinion is a normal part of cancer care.

When doctors have cancer, most will talk with more than one doctor before choosing their treatment. What's more, some health plans require a 2nd opinion. If your health plan doesn't cover the cost of a 2nd opinion, you have the choice of paying for it yourself.

If the two opinions are the same, you may feel more at peace about the treatment you accept to have. If the two opinions differ, think about getting a 3rd opinion. A 3rd opinion may help you decide between your options. Choosing your cancer treatment is a very important decision. It can affect your length and quality of life.

Support groups

Besides talking to health experts, it may help to talk to patients who have walked in your shoes. Ask your treatment team if there are online or telephone support options. There may also be a in-person support group that you can attend.

Support groups often consist of people at different stages of treatment. Some may be in the process of deciding while others may be finished with treatment. At support groups, you can ask questions and hear about the experiences of other people with leukemia.

Compare benefits and downsides

Every option has benefits and downsides. Consider these when deciding which option is best for you. Talking to others can help identify benefits and downsides you haven't thought of. Scoring each factor from 0 to 10 can also help since some factors may be more important to you than others.

> "Consider attending a support group for patients and caregivers. We may be available to share our survival story.
>
> – Jim
> Cancer Survivor
> Diagnosed at age 44 with myeloma then AML at age 64

Websites

AAMDS
aamds.org

Be The Match
bethematch.org

BMT InfoNet
bmtinfonet.org

Leukemia & Lymphoma Society
LLS.org/informationspecialists

National Cancer Institute (NCI)
cancer.gov/types/leukemia

NBMT Link
www.nbmtlink.org

NCCN for Patients®
nccn.org/patients

Review

- Shared decision-making is a process in which you and your doctors plan treatment together.
- Asking your doctors questions is vital to getting the information you need to make informed decisions.
- Getting a 2nd opinion, attending support groups, and comparing pros and cons may help you decide which treatment is best for you.

“

When my husband was diagnosed with AML, I lived in a constant state of shock for the first year. So much happened quickly around me. I felt completely unprepared for making decisions given what I understood. The daily commute to the hospital was very taxing. Throughout the process, my husband never seemed to become depressed or lose hope.

– Jeannette
Wife and caregiver

Glossary

Dictionary

acute myeloid leukemia (AML)
A fast-growing cancer of young white blood cells called myeloblasts.

allogeneic hematopoietic cell transplant (HCT)
A cancer treatment that replaces abnormal blood stem cells with healthy donor cells. Also called allogeneic stem cell transplant.

anemia
A health condition in which the number of red blood cells is low.

blast
A young blood cell that can't function like a mature blood cell.

blood stem cell
A blood-forming cell from which all other types of blood cells are formed. Also called hematopoietic stem cell.

bone marrow
The sponge-like tissue in the center of most bones.

bone marrow aspiration
A procedure that removes a liquid bone marrow sample to test for a disease.

bone marrow biopsy
A procedure that removes bone and solid bone marrow samples to test for a disease.

chemotherapy
Cancer drugs that stop the cell life cycle so cells don't increase in number.

chromosome
The structures within cells that contain coded instructions for cell behavior (genes).

clinical trial
A type of research that assesses health tests or treatments.

complete blood count (CBC)
A lab test that includes the number of blood cells.

complete remission
An absence of all signs and symptoms of cancer after treatment. Also called complete response.

comprehensive metabolic panel
Tests of up to 14 chemicals in your blood.

computed tomography (CT)
A test that uses x-rays from many angles to make a picture of the insides of the body.

consolidation
A shorter and more intense treatment phase to further reduce the number of cancer cells. Also called postremission therapy.

cytochemistry
The study of chromosomes using a microscope.

cytogenetic complete response
The absence of the hallmark—t(15;17)—after treatment for acute promyelocytic leukemia.

cytogenetics
The study of chromosomes using a microscope.

deoxyribonucleic acid (DNA)
A chain of chemicals in cells that contains coded instructions for making and controlling cells. Also called the "blueprint of life."

diagnosis
An identification of an illness based on tests.

differential
A lab test of the number of white blood cells for each type.

differentiation syndrome
A group of health signs and symptoms that is caused by leukemia or its treatments.

fibrinogen activity
A lab test of how well a protein called fibrinogen can help form a blood clot.

flow cytometry
A lab test of substances on the surface of cells to identify the type of cells present.

fluorescence in situ hybridization (FISH)
A lab test that uses special dyes to look for abnormal chromosomes and genes.

fusion gene
A coded instruction in a cell (gene) made from parts of two coded instructions.

gene
A set of coded instructions in cells for making new cells and controlling how cells behave.

hematopoietic cell
A blood-forming cell from which all blood cells are formed. Also called blood stem cell.

human leukocyte antigen (HLA)
A cell protein by which your body knows its own cells from foreign cells.

hyperuricemia
A health condition of too much uric acid in the body.

immunohistochemistry (IHC)
A lab test of cancer cells to find specific cell traits involved in abnormal cell growth.

immunophenotyping
A lab test that detects the type of cells present based on the cells' surface proteins.

induction
The first treatment that is given to greatly reduce the extent of cancer.

karyotype
lab test that makes a map of chromosomes to find defects.

lactate dehydrogenase (LDH)
A protein in blood that helps to make energy in cells.

lumbar puncture
A procedure that removes spinal fluid with a needle. Also called a spinal tap.

magnetic resonance imaging (MRI)
A test that uses radio waves and powerful magnets to make pictures of the insides of the body.

maintenance
A treatment phase that is given to prolong good treatment results.

medical history
A report of all your health events and medications.

megakaryocyte
A bone marrow cell that makes platelets.

molecular complete response
The absence of the *PML-RARA* gene after treatment for acute promyelocytic leukemia.

molecular testing
A lab test of any molecule in your body that can be measured to assess your health. Also called biomarker testing.

monitoring
A period of testing for changes in cancer status.

morphologic complete response
A large drop in blasts after treatment for acute leukemia.

mutation
An abnormal change in the instructions within cells for making and controlling cells.

myelodysplastic neoplasm (MDS)
A cancer of blood-forming cells that causes too few blood cells to form.

partial thromboplastin time
A lab test that assesses clotting factors from two of three pathways.

pathologist
A doctor who's an expert in testing cells and tissue to find disease.

physical exam
A review of the body by a health expert for signs of disease.

platelet
A type of blood cell that helps control bleeding. Also called thrombocyte.

polymerase chain reaction
A lab process in which copies of a DNA part are made.

positron emission tomography (PET)
A test that uses radioactive material to see the shape and function of body parts.

prognosis
The pattern and outcome of a disease.

prothrombin time
A lab test of how well all clotting factors work together.

recovery
A period of time without treatment to allow blood cell counts to return to normal.

red blood cell
A type of blood cell that carries oxygen from the lungs to the rest of the body. Also called an erythrocyte.

relapse
The return or worsening of cancer after a period of improvement.

side effect
An unhealthy or unpleasant physical or emotional condition caused by treatment.

supportive care
Treatment for the symptoms or health conditions caused by cancer or cancer treatment. Also sometimes called palliative care.

white blood cell
A type of blood cell that helps fight infections in the body. Also called a leukocyte.

Acronyms

AML
acute myeloid leukemia

APL
acute promyelocytic leukemia

ATO
arsenic trioxide

ATRA
all-trans retinoic acid

CBC
complete blood count

CBF
core binding factor

CT
computed tomography

DNA
deoxyribonucleic acid

FISH
fluorescence in situ hybridization

GO
gemtuzumab ozogamicin

HCT
hematopoietic cell transplant

HDT/ASCR
high-dose therapy with autologous stem cell rescue

HLA
human leukocyte antigen

IHC
immunohistochemistry

LDH
lactate dehydrogenase

MDS
myelodysplastic syndrome

MRI
magnetic resonance imaging

MUGA
multi-gated acquisition

NCCN
National Comprehensive Cancer Network

PET
positron emission tomography

PCR
polymerase chain reaction

TLS
tumor lysis syndrome

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For disclosures, visit www.nccn.org/about/disclosure.aspx.

NCCN Member Institutions

Fred & Pamela Buffett Cancer Center
Omaha, Nebraska
800.999.5465
nebraskamed.com/cancer

Case Comprehensive Cancer Center/ University Hospitals Seidman Cancer Center and Cleveland Clinic Taussig Cancer Institute
Cleveland, Ohio
800.641.2422 • UH Seidman Cancer Center
uhhospitals.org/seidman
866.223.8100 • CC Taussig Cancer Institute
my.clevelandclinic.org/services/cancer
216.844.8797 • Case CCC
case.edu/cancer

City of Hope Comprehensive Cancer Center
Los Angeles, California
800.826.4673
cityofhope.org

Dana-Farber/Brigham and Women's Cancer Center
Massachusetts General Hospital Cancer Center
Boston, Massachusetts
877.332.4294
dfbwcc.org
massgeneral.org/cancer

Duke Cancer Institute
Durham, North Carolina
888.275.3853
dukecancerinstitute.org

Fox Chase Cancer Center
Philadelphia, Pennsylvania
888.369.2427
foxchase.org

Huntsman Cancer Institute at the University of Utah
Salt Lake City, Utah
877.585.0303
huntsmancancer.org

Fred Hutchinson Cancer Research Center/Seattle Cancer Care Alliance
Seattle, Washington
206.288.7222 • seattlecca.org
206.667.5000 • fredhutch.org

The Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins
Baltimore, Maryland
410.955.8964
hopkinskimmelcancercenter.org

Robert H. Lurie Comprehensive Cancer Center of Northwestern University
Chicago, Illinois
866.587.4322
cancer.northwestern.edu

Mayo Clinic Cancer Center
Phoenix/Scottsdale, Arizona
Jacksonville, Florida
Rochester, Minnesota
800.446.2279 • Arizona
904.953.0853 • Florida
507.538.3270 • Minnesota
mayoclinic.org/departments-centers/mayo-clinic-cancer-center

Memorial Sloan Kettering Cancer Center
New York, New York
800.525.2225
mskcc.org

Moffitt Cancer Center
Tampa, Florida
800.456.3434
moffitt.org

The Ohio State University Comprehensive Cancer Center - James Cancer Hospital and Solove Research Institute
Columbus, Ohio
800.293.5066
cancer.osu.edu

Roswell Park Comprehensive Cancer Center
Buffalo, New York
877.275.7724
roswellpark.org

Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine
St. Louis, Missouri
800.600.3606
siteman.wustl.edu

St. Jude Children's Research Hospital
The University of Tennessee Health Science Center
Memphis, Tennessee
888.226.4343 • stjude.org
901.683.0055 • westclinic.com

Stanford Cancer Institute
Stanford, California
877.668.7535
med.stanford.edu

University of Alabama at Birmingham Comprehensive Cancer Center
Birmingham, Alabama
800.822.0933
www3.ccc.uab.edu

UC San Diego Moores Cancer Center
La Jolla, California
858.657.7000
cancer.ucsd.edu

UCSF Helen Diller Family Comprehensive Cancer Center
San Francisco, California
800.689.8273
cancer.ucsf.edu

University of Colorado Cancer Center
Aurora, Colorado
720.848.0300
coloradocancercenter.org

University of Michigan Rogel Cancer Center
Ann Arbor, Michigan
800.865.1125
mcancer.org

The University of Texas MD Anderson Cancer Center
Houston, Texas
800.392.1611
mdanderson.org

University of Wisconsin Carbone Cancer Center
Madison, Wisconsin
608.265.1700
uwhealth.org/cancer

Vanderbilt-Ingram Cancer Center
Nashville, Tennessee
800.811.8480
vicc.org

Yale Cancer Center/ Smilow Cancer Hospital
New Haven, Connecticut
855.4.SMILOW
yalecancercenter.org

Notes

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Acute Myeloid Leukemia

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