YOUR GUIDE TO
Understanding AML
(Acute Myeloid Leukemia)

www.aamds.org
The Aplastic Anemia and MDS International Foundation is a nonprofit health organization dedicated to supporting patients, families and caregivers coping with:

- Aplastic anemia
- Myelodysplastic syndromes (MDS)
- Paroxysmal nocturnal hemoglobinuria (PNH)
- Bone marrow/blood cancers including acute myeloid leukemia (AML), myelofibrosis, and chronic myelomonocytic leukemia (CMML)
- Related bone marrow failure diseases including pure red cell aplasia (PRCA) and inherited bone marrow failure syndromes

This guide is based on the most up-to-date research and has been carefully reviewed by independent experts. It provides important information about AML and treatment options. But remember, this guide isn’t a replacement for the advice of your doctor. If you have AML, you need to work closely with a medical specialist who knows how to evaluate your case of AML and select the best possible treatment for you.

For more information about AML or our Foundation, call (800) 747-2820 or go to www.aamds.org.

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JUST LEARNING ABOUT AML?

If you or a loved one was just diagnosed, you may feel a little overwhelmed right now. Acute myeloid leukemia (AML) is a blood and bone marrow cancer. Even though it is the most common type of leukemia, it is still quite rare. It is likely that you don’t know anyone who has had this condition.

But there’s some good news – there are effective treatments for AML that can help people feel better and live longer.

Right now, you need to learn as much as you can about AML, and this guide is the right place to start. It answers the basic questions you and your family are likely to have about the disease, the possible treatments, and what you can expect.

This guide will help you become an informed and effective member of your health care team.

The more you understand about your condition, the more in control you will feel and the more prepared you will be to work with your doctor and decide on your next steps.
What is AML?

Acute myeloid leukemia (AML) is a blood cancer. It happens when abnormal and immature white blood cells called blasts (leukemia cells), begin to fill up the bone marrow. This stops your bone marrow from making all the normal, healthy blood cells you need.

Doctors diagnose AML when at least 20 out of every 100 white blood cells in the bone marrow or blood is a blast cell.

How is AML Related to Other Bone Marrow Failure Diseases?

Over time, about 1 in 3 cases of myelodysplastic syndrome (MDS) will evolve to become AML. The risk of developing AML depends largely on which MDS subtype you have at the time of diagnosis.

- A patient with lower-risk MDS has up to a 2 in 10 chance of developing AML.
- A patient with higher-risk MDS has more than a 4 in 10 chance of developing AML.

A smaller number of people with aplastic anemia and paroxysmal nocturnal hemoglobinuria (PNH) go on to develop AML. Patients with myeloproliferative neoplasms such as myelofibrosis, or with certain inherited conditions such as Down syndrome, also have a higher risk of developing AML.

If you have AML, you’re not alone. In the United States:

- AML is the most common acute leukemia affecting adults
- About 20,000 new cases of AML are diagnosed each year
WHAT CAUSES AML?

AML can occur at any age but is more common in older people. For most people with AML, there is no easily identifiable cause.

We know a few things can increase your chance of getting AML:

- Having had regular contact with benzene or other harmful chemicals (organic solvents)
- Smoking tobacco, or having been a smoker
- Having certain uncommon genetic conditions such as Down syndrome, Fanconi anemia, dyskeratosis congenita, MonoMAC syndrome, Bloom syndrome, Shwachman-Diamond syndrome or Diamond-Blackfan syndrome
- Having other blood cancers like myelodysplastic syndromes (MDS), polycythemia vera (PV), primary myelofibrosis (MF), or essential thrombocythemia (ET)
- Previous chemotherapy or radiation treatments for other cancers

Other risk factors for AML

Some people are more likely to develop AML than others. This includes:

- Men — AML is a little more common in men than women
- Age 60 or older — As you get older, your chance of getting AML increases. But AML can occur at any age.

Even though AML is linked to changes in your chromosomes (the part of a cell that carries genes), it can’t be passed on to your children and it doesn’t typically run in families. You also can’t catch it from someone else.
**HOW DOES AML AFFECT BLOOD CELLS?**

To better understand AML, it helps to know a little bit about the different kinds of blood cells and how your body makes them.

Your blood carries 3 different kinds of blood cells. Each one has an important role to play.

- **Red blood cells** carry oxygen from your lungs to all the cells in your body.
- **White blood cells** protect you by attacking germs. There are many different types of white cells to fight different germs (i.e. viruses, bacteria, fungus).
- **Platelets** help your blood clot and stop bleeding.

Your bone marrow — a spongy tissue inside some of your bones — is like a factory that makes all of these blood cells. Normally, special cells inside your bone marrow (called blood-forming stem cells) grow into all the healthy red blood cells, white blood cells, and platelets your body needs.

If you have AML, one or more of your blood-forming stem cells has become damaged. This damaged stem cell then makes abnormal blood cells called blasts. These blast cells never mature (become full-grown). They begin to fill up the bone marrow and are also pushed into the circulating blood.

So, people with AML have too many abnormal blast cells in their bone marrow and don’t have enough healthy blood cells in their blood. This can make them feel sick with a variety of symptoms. Learn more about these symptoms in the next chapter.
AML is a blood cancer that affects blood cells and bone marrow. In most cases, we don’t know why people get AML. AML makes you sick because it stops your body from making healthy red blood cells, white blood cells, and platelets. Instead, your body makes cells that aren’t normal — including blasts, which are cells that are immature (not full-grown). These cells begin to fill your bone marrow.
Know Your Symptoms

The symptoms of AML can be very different from person to person. Some people have very bad (severe) symptoms. Others have more mild symptoms.

Remember that AML causes low blood cell levels. So your symptoms often depend on whether you are low on red blood cells, white blood cells, or platelets.

“I just joined a support group for people with leukemia. I was surprised to find out that people can have such different symptoms. Many people have a low red cell count like me, but other folks had a low white cell count or a low platelet count.”

—Samuel

Patients with AML may initially have non-specific (general) symptoms. These symptoms are what often prompts a doctor visit. They can include:

- Fatigue
- Fever
- Night sweats
- Loss of appetite
- Weight loss
- Bruising or bleeding
- Recurrent infections

Of course, these are not just symptoms of AML. They can be caused by other things too. Having these symptoms does not mean you have AML.
SYMPTOMS CAUSED BY LOW BLOOD COUNTS:

Low red blood cell levels (anemia)
Red blood cells carry oxygen to your cells. Having a low level can make you feel tired and rundown. You may notice changes in how you feel, like:
- Getting more tired when you’re active or having trouble staying active
- Not being as hungry as usual
- Having a harder time thinking clearly or concentrating

You may notice other symptoms like:
- Headaches
- Pale skin
- Trouble breathing, especially when you’re physically active
- Fast heartbeat or chest pain
- Weight loss
- Swelling in your ankles and legs

Low white blood cell levels (leukopenia or neutropenia)
If you don’t have enough healthy white blood cells to fight germs, you may get sick more often and have more infections. It can also take you longer to feel better. Symptoms include:
- Mouth sores
- Stuffy nose and sinus infections
- Throat infections
- Skin infections
Lung infections including pneumonia or bronchitis

Bladder infections that may make it hurt to urinate or make you urinate more often

**Low platelet levels (thrombocytopenia)**

Platelets help your blood clot so you stop bleeding. When you have low platelet levels you may:

- Bruise or bleed more easily, even from small scrapes and bumps
- Have bleeding gums, especially after brushing your teeth or seeing the dentist
- Get nose bleeds
- Bleed under the skin, causing tiny, flat, red spots — called petechiae — most often on your lower legs

**OTHER SYMPTOMS YOU MIGHT EXPERIENCE**

**Leukostasis Caused by High Numbers of Blasts in the Blood**

AML blast cells are bigger than normal white blood cells. They may have more trouble going through tiny blood vessels. These cells can clog blood vessels making it hard for normal red blood cells (and oxygen) to move through your body. When this happens it is called leukostasis. This complication of AML is rare, but it is a medical emergency. It must be treated right away. Some of the symptoms are similar to a stroke and include:

- Headache
- Weakness in one side of the body
- Slurred speech
- Difficulty breathing
- Confusion
- Sleepiness
**Bleeding and clotting problems**

Patients with AML might have trouble with bleeding and clotting. This might include a nose bleed that won’t stop, or a cut that won’t stop bleeding. They may also have calf swelling from a blood clot called a deep venous thrombosis (DVT) or chest pain and shortness of breath from a blood clot in the lung (called a pulmonary embolism or PE). Patients with a certain type of AML called acute promyelocytic leukemia (APL or APML) are most likely to have a PE complication.

**Bone or joint pain**

Some patients have bone pain or joint pain caused by the buildup of leukemia cells in these areas.

**Swelling in the abdomen**

Leukemia cells may collect in the liver and spleen, causing them to enlarge. This may be experienced as a fullness or swelling of the belly. The lower ribs usually cover these organs, but when they are enlarged the doctor may be able to feel them.

**Rashes on the skin**

If leukemia cells spread to the skin, they can cause lumps or spots that may look like common rashes.

**Swelling of the gums**

Certain types of AML may spread to the gums, causing swelling, pain, and bleeding.
Other organs that may be affected

Sometimes, leukemia cells can spread to other organs such as the brain, spinal cord or lymph nodes. This can cause symptoms like:

- Headaches
- Weakness
- Seizures
- Vomiting
- Trouble with balance
- Facial numbness
- Blurred vision
- Enlarged lymph nodes in the neck, groin, underarm areas, or above the collarbone

**REVIEW**

- Initial AML symptoms can be general, like tiredness, fever or weight loss
- Low red blood cell levels can make you feel tired and run down
- Low white blood cell levels raise your risk of getting infections
- Low platelet levels can make you bruise or bleed easily
- Other symptoms can be caused by AML blast cells collecting in certain organs like the bones, liver, skin, brain, or lymph nodes
Discover Your Diagnosis

Your doctor has a few different ways of figuring out if you have AML, and if you do, what subtype it is.

They include taking a medical history, blood tests, and bone marrow tests. Getting the right diagnosis is key because it helps your doctor decide which treatments will work best.

If you have AML, your doctor will want to do regular tests of your blood and may also need to test your bone marrow. These tests are an important way of diagnosing AML and of seeing whether your AML has gotten better or worse. It’s also a good way to find out if treatment is working.

“I was feeling run down. At first my doctor thought I might have the flu. After a month of feeling too tired to get off the couch and lots more tests, my doctor diagnosed me with AML.”

— Janet

**Medical History**

This is usually the first step in getting a diagnosis. Your doctor may ask questions about how you’re feeling now like:

- Have you noticed any symptoms?
- Are you feeling tired?
- Have you had a fever or any infections recently?
- Have you had bruises or cuts that take longer to stop bleeding?
Your doctor may also ask questions to try to understand why you may have developed AML, like:

- Have you ever had chemotherapy or radiation treatments for cancer?
- Have you ever had regular contact with harmful chemicals, like benzene?
- Do you smoke now or have you been a smoker?

**BLOOD TESTS**

Your doctor will want to test your blood to check for signs of AML. You’ll give a small sample of blood that will be sent to a lab. The lab will test the sample in different ways.

**Complete blood count (CBC)**

This test counts the number of blood cells in your sample. Blood counts are a way of finding out if you’re low on red blood cells, white blood cells, or platelets.

When you get your CBC results back from your doctor, you may see a lot of different terms and numbers.

Check out Appendix A to learn more about how to read and understand your CBC results.
**Blood Cell Examination**

This is also called a blood smear. For this test your doctor will look at your blood cells under a microscope. A person with AML may have blast cells in the blood. These cells do not work like normal cells.

**Bone Marrow Tests**

You need to have bone marrow tests to confirm that you have AML. Your doctor will typically take a sample of liquid bone marrow (aspirate) and a small piece of bone and solid marrow (core).

Bone marrow tests show:

- The type of cells your bone marrow is making and how many
- Levels of abnormal blast cells (immature white blood cells) and other cells that aren’t normal
- Signs of damage to your bone marrow (fibrosis, a kind of scar tissue)

Your doctor may run some other special tests on your bone marrow samples, like:

- Cytogenetics or karyotyping and FISH (fluorescence in situ hybridization), that check for problems in the chromosomes in your bone marrow
- Flow cytometry, that shows the types and amounts of different cells in your bone marrow, including blasts
- Genomic analysis, or sequencing of genes in the bone marrow cells, to check for changes (mutations) in your genes
What to expect from a bone marrow test

Your doctor will probably take bone marrow samples from the back of your hipbone. Here’s what usually happens:

- You lie down on an exam table on your belly or on one side
- You may get some medicine to help you feel relaxed
- You’ll get a shot of medicine in the skin (local anesthetic) to make the area numb
- Your doctor will put a needle through your skin into the bone to get samples of your bone marrow

The test can hurt, but usually just for a few moments. Afterward, you may be sore for a few days and bruised and notice a little bleeding. Your doctor may suggest you take acetaminophen (Tylenol®) for pain. Aspirin and non-steroidal anti-inflammatory drugs (NSAIDs) — like Advil® — may not be safe, because they can make bleeding worse due to their effect on blood platelets.

Infections in the skin after a bone marrow test are not common, but they can happen. Ask your doctor for signs of infection you should watch for. They can include:

- Fever
- Redness or swelling at the site of the test
UNDERSTANDING DE NOVO VS SECONDARY AML

De novo means brand new, and refers to the first time something occurs. AML that is untreated and has no known cause is called de novo AML.

Secondary or therapy-related AML means the cancer is caused by:

- Having another blood cancer like myelodysplastic syndromes (MDS) or a myeloproliferative neoplasm (MPN)
- Having an underlying inherited bone marrow failure syndrome like Fanconi Anemia or dyskeratosis congenita
- Having had treatment for other cancers, like breast cancer, using chemotherapy or radiation therapy

TYPES OF AML

Knowing your AML subtype is important. It helps your doctor make the best treatment recommendations for you. It also helps your doctor understand how your AML might progress over time.

Doctors these days mostly use the World Health Organization (WHO) classification system, one of two systems to classify AML subtypes.

The WHO classification system was created in 1999 and updated in 2016. This classification system considers many factors, including, but not limited to:

- Genetic changes in your bone marrow cells (cytogenetics and molecular genetics)
- Whether your bone marrow cells look abnormal under a microscope (myelodysplastic)
- If you have had previous chemotherapy or radiation
- If you have Down syndrome or another rare inherited condition. This is often important for children and younger adults

The French American British (FAB) is an older system, not commonly used today. It assigns patients to one of eight AML types: MO, M1, M2, M3, M4, M5, M6 or M7. Most types are treated using the standard AML chemotherapy options. But patients with type M3 (acute promyelocytic leukemia, or APL or APML for short) need a different treatment plan. Find more information about APL and its treatment on page 27.

See Appendix B to learn more about the FAB and WHO classification systems.

UNDERSTANDING YOUR RISK

Recently research has focused on the reasons why some AML patients respond better to treatment and or have a durable (more lasting) response to treatment. These are called predictive and prognostic factors.

These factors help your doctor better understand how your disease might progress over time. They also help your doctor understand how you might respond to treatment, which helps your doctor decide the best course of treatment for you.
Some of these predictive and prognostic factors include:

- Your AML subtype based on the WHO classification system
- Genetic changes or mutations in your AML cells. Some genetic changes predict a better outcome. Others predict a less favorable outcome
- Your age (over age 70 is often less favorable)
- White blood cell count (it is a little better if your white blood cell count is less than 100,000)
- Having a previous blood disorder like MDS or MPN
- Prior treatment for another cancer with chemotherapy and/or radiation (surgery does not increase risk)
- An active blood infection
- Chronic diseases such as serious kidney, liver, lung or heart disease during therapy may make the leukemia more difficult to treat
- Leukemia cells in the central nervous system put you at increased risk

**REVIEW**

- Doctors use blood tests and bone marrow tests to diagnose AML
- They also use test results to figure out what type of AML you have and how to treat it
- AML patients need regular testing so doctors know how the patient is doing and if treatment is working
Understand Your Treatment Options

AML is a complex disease, and there are a lot of different types of treatments. But you and your doctor will work together to figure out the best treatment options for you.

The goal of treatment for AML is to cure the disease and help you live longer. There has been improvement in treatment outcomes in recent years for people with all types of AML.

- Almost half of children with AML are cured
- Patients with acute promyelocytic leukemia (APL) have a very high cure rate overall compared to adults with other AML types
- Some adults with other types of AML may be cured or have long periods of remission

CHEMOTHERAPY

Chemotherapy to treat AML is usually done in two phases. The first phase aims to put the patient into remission. It is called induction therapy. The second phase is aimed at stopping the AML from returning. This is called post-remission therapy.

Induction chemotherapy

The first phase of your treatment is called induction therapy. Its goal is to “induce” (bring on) remission (when no evidence of the disease is left). The goal of induction therapy is to:

- Kill as many AML cells as possible with chemotherapy
- Get healthy blood cell counts back to normal or near normal
"Until recently there weren’t a lot of treatment options for people with AML. It’s different now – there are a number of good options to choose from. It’s nice to know I have choices”.
—Michael

What are the types of treatment used for AML induction therapy?
For induction therapy, doctors typically combine two or more chemotherapy drugs. Each type of drug works in a different way to kill the cancerous cells. Combining drug types can make them more effective. Some patients may be too frail or have too many medical problems to receive induction therapy.

Most AML patients are treated with a combination of an anthracycline (such as daunorubicin (Cerubidine®) or idarubicin (Idamycin®) and cytarabine (also called cytosine arabinoside or ara-C (Cytosar-U®)).

Other drugs may be added or substituted for higher-risk patients, if the initial drugs don’t work, or if the AML reoccurs after remission. Sometimes targeted (specific) drugs can be added that treat an AML patient with a specific genetic abnormality.

How are these drugs given?
Chemotherapy drugs are given through a catheter also known as a central line (a thin, flexible tube or intravenous line, surgically placed in a vein, most commonly in the upper chest).
Anthracycline is usually given in the first 3 days of treatment, typically as an intravenous infusion lasting from 15 to 60 minutes. Cytarabine is started at the same time but is given as a continuous infusion 24 hours a day, usually for 7 days. This treatment is called “7 plus 3” (or “3 plus 7”).

Is induction therapy treatment done?

Induction therapy happens in the hospital. A recovery period is required afterwards, so it usually requires a hospitalization of 4 to 6 weeks.

You may have to go through more than one round of induction therapy before you go into remission. Usually the same drugs are used for more rounds of treatment, sometimes in a shortened course called “5 and 2”. Often a bone marrow biopsy is done about 14 days after the 3 plus 7 starts in order to see if the blast cells have gone away and if more chemotherapy is required.

Central Lines, Ports and PICCs

Central Line

This is a thin tube that is put under the skin and into a large vein in the chest. The central line stays firmly in place. Catheter is another word for central line.

Port

This is a small device that is used with a central line. The port is placed under the skin of the chest. After the site heals, no dressings are needed and no special home care is needed. To give medicines or nutrition or to take blood samples, the doctor or nurse puts a needle through the skin into the port. A numbing cream may be put on the skin before the port is used.

PICC or PIC Line

PICC or PIC line is short for percutaneously inserted central venous catheter (or peripherally inserted central catheter, or peripheral indwelling central catheter). A PICC is inserted through a vein in the upper arm.
Quick Facts about AML Treatment

■ Some patients who have AML are cured with treatment. Many need treatment as soon as possible after diagnosis.
■ AML patients should be treated by doctors who are skilled in treating patients with AML. This is usually a hematologist/oncologist in a major medical center.
■ Each patient’s treatment plan is based on his or her AML test results.
■ The initial goal of treatment is usually to get the patient into remission. A remission means that there is no sign of AML cells in the blood or marrow or anywhere else in the body; blood cell counts are back to normal or near normal.
■ Many older patients can be treated for AML and enter remission.
■ Most patients need chemotherapy to achieve remission. Typically, at least two drugs are combined to treat patients. This first stage of treatment is called remission induction therapy. Some patients may be too old or too frail to undergo standard remission induction therapy.
■ More treatment is needed once a remission is achieved to help prevent a relapse or recurrence of the AML. This is called post-remission therapy.
■ Post-remission therapy may include chemotherapy or stem cell transplantation.
■ Patients may have a return of AML after treatment. This is called a relapse.
Understand Your Treatment Options

Post-remission therapy (consolidation therapy)

After induction therapy is complete and the patient is in remission, there will be a second phase of treatment. This is called “post-remission therapy,” or “consolidation therapy.” This phase of treatment aims to destroy any remaining AML cells that may not be detected in blood and bone marrow tests. Without post-remission therapy, AML is likely to return.

What type of treatment is used for AML post-remission therapy?

Post-remission therapy may consist of additional intensive chemotherapy. It may also include stem cell transplantation as a form of post-remission therapy. If stem cell transplantation is not used, the treatment will generally consist of up to four cycles of chemotherapy.

For best results, intensive chemotherapy is given with high doses of cytarabine or other drugs. Which therapy, what drug, and for how many cycles therapy is given depends on:

- AML subtype
- Cytogenetic and molecular results
- Patient age and medical history

Where is the treatment done?

Post-remission therapy happens in the hospital and the length of stay depends on the treatment and other factors.
Chemotherapy drugs currently used include:

- Anthracyclines (Antitumor Antibiotics)
  - daunorubicin (Cerubidine®); daunorubicin and cytarabine fixed-combination therapy (Vyxeos®); idarubicin (Idamycin®); mitoxantrone (Novantrone®);

- Antimetabolites
  - cladribine (2-CdA; Leustatin®); clofarabine (Clolar®); cytarabine (cytosine arabinoside, ara-C; Cytosar-U®); fludarabine (Fludara®); hydroxyurea (Hydrea®); methotrexate; 6-mercaptopurine (Purinethol®); 6-thioguanine (Thioguanine Tabloid®)

- Topoisomerase Inhibitors
  - etoposide (VP-16; VePesid®, Etopophos®); topotecan (Hycamtin®)

- DNA-Damaging Agents (alkylating agents)
  - cyclophosphamide (Cytoxan®)

- Cell-Maturing Agents
  - all-trans retinoic acid (ATRA, tretinoin; Vesanoid®); arsenic trioxide (Trisenox®)

- Hypomethylating Agents
  - azacitidine (Vidaza®); decitabine (Dacogen®)
Targeted therapies for AML

Abnormalities in certain genes of a patient’s AML cells (e.g. KIT, FLT3-ITD, CEBPA, NPM1, and TP53) help doctors determine what therapy to provide. Newer treatments are becoming available that target these genetic abnormalities. For example, a drug called midostaurin (Rydapt®) was recently approved to treat AML with a FLT3 gene mutation.

Other targeted therapies are currently being tested using clinical trials.

Treating acute promyelocytic leukemia (APL or APML)

Acute promyelocytic leukemia is a subtype of acute myeloid leukemia (AML). It is the most curable subtype of AML. Patients with APL need different treatment than patients with other AML subtypes.

APL patients are treated with the drug all-trans retinoic acid (ATRA). This drug is also called tretinoin (Vesanoid®). ATRA alone can lead to a short-term remission in many patients. But ATRA given with other drugs helps many patients to have long-lasting remissions. Arsenic trioxide (Trisenox®) is another drug used to treat most APL patients.

APL patients with a very high white cell count at diagnosis may need more chemotherapy than other patients.

A recent study found that for APL patients with a low or standard (normal) risk profile, ATRA given together with arsenic trioxide as induction and consolidation therapy is as good as ATRA combined with chemotherapy.

Some high-risk APL patients may be treated with an allogeneic stem cell transplant if a matched stem cell donor is available. See page 20 for more on stem cell transplantation.
Stem cell transplantation

In this treatment, all of your damaged bone marrow stem cells are replaced with healthy stem cells from a donor. For many patients, this is the only AML treatment that offers the possibility of a cure. The decision to choose chemotherapy or stem cell transplantation needs to be made in close consultation with an experienced leukemia specialist. Despite its potential to cure AML, stem cell transplantation has serious risks, including death.

Stem cell transplantation also works best in patients who:

- Are generally healthy and don’t have other serious medical conditions
- Are younger than about age 75

Finding a stem cell donor

To get a stem cell transplant, you need to find a donor who has cells that closely match your own. Usually, you look for a donor in your family — most commonly a brother or sister with the same mother and father. Your doctor will need to do special tests to make sure a donor is a full match. A sibling has a one in four chance of being a match.

The age of the donor matters too. Transplants using stem cells from a younger donor (under age 40) have better results.

If you don’t have a brother or sister who is a match — or if your family members are older than age 55 — your doctor may look outside your family for an unrelated donor. An adult child or a parent may also be a suitable donor in some cases. To find an unrelated donor, your doctor will use a bone marrow donor registry managed by the National Marrow Donor Program. Learn more by visiting their website at www.bethematch.org.
If you can’t find a suitable donor, other possible options include:

- **Cord blood transplant**: This uses stem cells taken (and frozen) from a baby’s umbilical cord and placenta right after birth. Cord blood does not need to be fully matched for transplant.

- **Half-matched donors**: Usually, you would need a fully matched donor for a stem cell transplant. But some transplant centers are able to use half-matched donors. This makes it easier to find a possible donor. Your children or parents are usually half-matched. Doctors call this a haploidentical transplant. However, the risk for such a transplant is somewhat higher.

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**What to expect**

Stem cell transplantation is a serious and complex medical procedure.

- You check into the hospital for chemotherapy, immune suppression therapy, and maybe radiation to destroy most of your bone marrow

- You will have to stay in the hospital to protect yourself from getting an infection during this time — this could be as short as 2-3 weeks to more than a month

- Your doctor will add healthy stem cells from your donor into your blood. This is the actual transplantation procedure

- If it works, the new healthy stem cells will move into your marrow and start copying themselves — this is called engraftment and it can take up to 1 month

- Your doctor will watch your blood cell levels to see if the new cells are working correctly
If everything goes well, the new, healthy cells will take over and start making all the red blood cells, white blood cells, and platelets you need. About 4 out of 10 people who get a stem cell transplant for AML are potentially cured.

**Side effects and risks**

Stem cell transplants have serious risks and you need to talk them over with your doctor. You will have side effects from chemotherapy and radiation, like infections and low blood cell levels. In some cases the donated stem cells (the graft) can start to attack the recipient’s (host’s) tissues. This is called graft-versus-host disease (GVHD) and it can be life threatening.

**Treating AML in children**

There are about 500 new cases of AML each year in the United States in children younger than 15 years. About 4 out of 5 children with AML go into remission. Over half of children with AML have no signs of disease after 5 years. More than half of these children are considered cured.

Induction therapy for children with AML starts with two or three drugs. More treatment is needed after a child with AML is in remission (post-remission therapy). It is given because some AML cells may remain after induction therapy. These AML cells do not show up in standard blood or marrow tests. Post-remission therapy in children includes a number of chemotherapy drugs.

AML treatment is less likely to bring about a remission or cure in children:

- With very high white cell counts
- Younger than 2 years old
- With certain chromosome changes in their AML cells
Stem cell transplantation may be used in children who are not doing well or whose AML returns after high-dose chemotherapy. Doctors will discuss the benefits and risks of allogeneic transplantation with parents and older children.

### Treating AML in older or frail patients

AML is more common in older patients. At least half of patients are over 65 years old when their disease is diagnosed.

Today, most older people with AML can receive some treatment, including those who may have other serious health problems. However, while remission is possible, treatment results in older adults are not as good as treatment results in younger adults and children.

Some healthy older patients can be treated with the same doses of chemotherapy as younger adults. Sometimes older patients have other medical problems, such as heart disease, kidney or lung disease, or diabetes. The doctor takes these other problems into account to decide which drugs to use and in what dosage. Recently, lower intensity treatment regimens have been developed to help an older patient maintain a good quality of life and still control the AML without achieving a cure.

The doctor will also consider:

- The type of AML
- The patient’s physical ability to handle the treatment
- The patient’s feelings about the treatment approach

Some older patients might also consider a reduced-intensity allogeneic stem cell transplant. See page 28 for more information.
Understanding Your Treatment Options

Side effects of treatment

The aim of treatment for AML is to kill AML cells. But treatment for AML also affects healthy cells. The term “side effect” describes the way a treatment affects healthy cells. Side effects of AML treatment may be severe, but they usually go away once treatment ends. Ask your doctor about the side effects to expect from your treatment.

AML treatment may affect your blood cell counts.

The number of your red blood cells may decrease (anemia). Red cell transfusions (red cells that are donated and given to the patient) may be needed to increase red cell counts.

Patients may also have a drop in the number of platelets. A platelet transfusion may be needed to prevent bleeding if a patient’s platelet count is very low.

A big drop in the number of white cells may lead to an infection. These infections are usually treated with antibiotics. Fever or chills may be the only signs or symptoms of infection. However, an AML patient with low blood counts can have a severe infection without a fever. Patients with an infection may also have

- Coughing
- Sore throat
- Pain when urinating
- Frequent loose bowel movements.

White cell growth factors are sometimes given to increase the number of white blood cells. G-CSF (Neupogen®, Granix®, Neulasta®) and GM-CSF (Leukine®) are drugs that increase white cell counts.
Understand Your Treatment Options

Chemotherapy also affects the parts of the body where new cells form quickly. This includes the inside of the mouth and bowel and the skin and hair. The side effects listed here are common during chemotherapy:

- Mouth sores
- Diarrhea
- Hair loss
- Rashes
- Nausea
- Vomiting

Not all patients have these side effects. Treatment to prevent or manage nausea, vomiting, diarrhea and other side effects can help patients feel more comfortable.

**Long-term and late effects**

Long-term effects are medical problems that last for months or years after treatment ends. Fatigue is an example. Late effects are medical problems that do not show up until years after treatment ends. Heart disease (weakening of the heart muscle) is an example.

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**Tips to lower the risk of infection:**

- The patient’s visitors and medical staff should wash their hands well
- The patient’s central line must be kept clean
- Patients should take good care of their teeth and gums
Understand Your Treatment Options

Children and adults who have been treated for AML need to see their doctor for follow-up care.

Children who are treated for AML may have

- Growth problems
- Fertility problems (ability to have children later on)
- Bone problems
- Heart problems
- Learning problems

Adults who are treated for AML may have

- Fertility problems
- Thyroid problems
- Bone problems
- Problems concentrating
- Persistent fatigue

Patients should talk with their doctors about any long-term or late effects that may be related to their treatment. Parents should talk to the doctor about when their child’s learning skills should be checked.
Chemotherapy to treat AML is usually done in two phases. The first phase is induction therapy which aims to put the patient into remission. The second phase is called post-remission therapy which aims to stop the AML from returning.

Targeted therapies for AML are available to treat patients with certain genetic mutations in their leukemia cells.

Acute promyelocytic leukemia (APL), a subtype of acute myeloid leukemia (AML), is the most curable subtype of AML. Patients with APL need different treatment than patients with other AML subtypes.

Stem cell transplantation replaces damaged AML cells in your bone marrow with healthy ones from a donor.

AML in children is rare, but very treatable. About 4 in 5 children with AML go into remission.

Treatments are now available for older and frailer patients. Some can put patients into remission.

Infections in AML patients need to be rapidly evaluated by a doctor and quickly treated if necessary.

It is important to know what side effects you might expect from treatment – and to tell your doctor what you are experiencing. Good treatments are available to prevent or manage nausea, vomiting, diarrhea and other side effects to help patients feel more comfortable.
Explore Clinical Trials

Clinical trials are another treatment option for some people with AML. Before people can use a new AML treatment, it has to be tested. These tests are called research studies or clinical trials.

All of the current AML treatments started in clinical trials. Clinical trials in hospitals and research centers are an essential way for experts to develop better therapies by learning:

- Whether a new treatment works and is safe
- How new treatments — or new combinations of treatments — compare with older ones

Clinical trials are options at any stage of treatment. Think about joining a clinical trial, particularly if:

- Your AML is newly diagnosed or relapsed AML
- Regular treatments have not made your AML better
- Your AML is a high-risk subtype
- A targeted agent is available for your AML genetic subtype
- Your AML has come back after treatment (relapse)
- You don’t like your treatment options right now

Taking part in a clinical trial has benefits:

- You’ll get excellent care from AML experts
- You could get access to a new, cutting-edge treatment for AML
- The results of the clinical trial could also help you or other people who have AML now or in the future
Clinical trials test new treatments and approaches for AML. Taking part in a clinical trial has possible benefits and risks – so you need to talk them over with your family and doctor. But clinical trials also have risks:

- You don’t know if the treatment you’re getting will actually help
- You could have unexpected side effects or other problems

Clinical trials aren’t right for everyone with AML. Before you decide to take part in a clinical trial, think it over carefully. Discuss the pros and cons with your doctor. Talk it over with your family.

For more information about clinical trials:

- Visit www.aamds.org/clinicaltrials and www.clinicaltrials.gov
- Call (800) 747-2820 and ask to speak with our Information Specialist

REVIEW

- Clinical trials test new treatments and approaches for AML
- Taking part in a clinical trial has possible benefits and risks – so you need to talk them over with your family and doctor
Take Control of Your Care

Now that you’ve learned more about AML, you’re ready to take the next steps. Here are 6 things you can do to take charge of your care — and feel more confident about your future.

“If you have AML, you can’t go it alone! It took me a while to realize I needed to ask for help. Once I had a team of family and friends together, I felt a lot better about getting through treatment.”

— Carlita

1. Find a doctor you trust

You and your AML doctor need to be a team. You’ll probably be working together for a long time.

So if you haven’t already found an AML expert, you need to do this right away. Two types of doctors specialize in treating AML, and either one can be a good choice:

- Hematologists, who focus on treating problems with the blood and bone marrow
- Oncologists, who focus on treating cancer
To get the names of AML doctors in your area, you can:

- Ask your regular doctor or insurance company for the names of experts in your area
- Call the nearest medical school with a teaching hospital or a designated Cancer Center, which often has more specialized programs and physicians
- Call the Aplastic Anemia and MDS International Foundation’s HelpLine at (800) 747-2820 or write to help@aamds.org

Think about getting a second opinion. Seeing a second expert can help you understand all your choices and decide on a treatment plan. Some health insurance plans actually require a second opinion.

When you first meet a doctor, imagine that you’re interviewing him or her for a job. Make sure you’re a good match and that the doctor makes you feel comfortable, really listens to you and answers all your questions.

2. Be prepared for doctor visits

It’s easy to forget important questions when you’re sitting in the doctor’s office. So before every check-up, make sure that you:

- Take a list of questions you wrote down earlier. See page 47 at the end of this section for some ideas of what to ask.
- Take a notebook to write down what your doctor says, or ask a family member to take notes for you.
- If you don’t understand something, ask your doctor to explain. Remember, the doctor is there to help you.
3. Keep track of your information

Keep all of your AML information in one place — along with your lab results and medical records. You can store them all in a notebook, on your computer, or online using a phone or tablet app.

4. Work together on a treatment plan

Your treatment plan is like a roadmap. It shows what treatments you need now and what you may need in the future. Your doctor will make changes to your treatment plan over time.

The best treatment plan depends on a lot of different things like:

- Your symptoms
- Your age
- Your blood cell levels
- Your overall health
- Your AML subtype (see Appendix B)

Take a good look at the treatment plan your doctor suggests. Make sure you understand it and that it seems like the right approach. Having a good treatment plan will make you feel more in control and more positive about the future.

5. Get support

Living with AML and going through treatment can be hard. Sometimes you may feel tired, sick, or worried.

That’s why it’s so important to ask for help. See if family members or friends can take over some chores, like shopping or driving you to and
from doctor’s appointments. You may be surprised by how many people really want to help out if you ask.

Think about making an appointment with a counselor or therapist. Try to find someone with experience helping people deal with health issues like AML.

You can also ask your doctor about support groups for people with AML. Joining a support group can be a great way to share experiences and get tips on managing life with AML. Meeting folks who truly understand what you’re going through can make a big difference.

6. Lower your stress levels

It’s easy to get overwhelmed or feel down when living with a serious illness. You might stop doing things you used to love. You might isolate yourself from others. Medicines and other treatments can help your symptoms and blood cell levels. But they may not help how you feel emotionally.

That’s why trying mind-body therapies — which focus on lowering stress and boosting your mood — is a great idea. These therapies can also help with pain and give you more energy. Look into treatments like:

- Relaxation techniques, like meditation, deep breathing exercises, and aromatherapy
- Gentle physical activity, like yoga, tai chi, and chi gong
- Massage therapy, acupuncture, reiki, or healing touch

Check with your doctor before trying a mind-body therapy. Discuss which ones might be best for you. You can also find out if your hospital or medical center has an integrative medicine specialist on staff. These are experts in using mind-body therapies to help people feel better.
Other simple things that can help are:

- Going on walks
- Sitting outside and enjoying nature
- Laughing more — by watching funny movies or reading funny books
- Writing in a journal — especially about what you feel grateful for
- Enjoying hobbies, like knitting, coloring, or gardening

Learn more about living with AML

The Aplastic Anemia and MDS International Foundation (AAMDSIF) can help. Contact us to:

- Get support from our Information Specialists
- Connect with other AML patients through the AAMDSIF Peer Support Network
- Find out more about our patient and family conferences at www.aamds.org/conferences
- Call us at (800) 747-2820 or visit www.aamds.org
Appendix A: Understanding Key Lab Results

When you get your lab results back from the doctor, you may wonder what all those terms and numbers mean. This section will help you understand two types of results — your complete blood count and your blast count.

**COMPLETE BLOOD COUNT (CBC)**

Complete blood count is a way of checking your blood cell levels. It’s one test, but it gives you many results and details about the health of your blood cells. Compare your CBC results with what you see below.

<table>
<thead>
<tr>
<th>CBC Test Result</th>
<th>What is it for?</th>
<th>What’s normal for adults?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red blood cell count (RBC)</td>
<td>Checks the number of red blood cells in your blood sample</td>
<td>Men: 4.4 to 5.8 million cells/mcL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Women: 3.9 to 5.2 million cells/mcL</td>
</tr>
<tr>
<td>Hemoglobin (Hgb)</td>
<td>Checks the amount of a protein that carries oxygen in red blood cells — people with anemia have a low level</td>
<td>Men: 13.8 to 17.2 grams/dL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Women: 12.0 to 15.6 grams/dL</td>
</tr>
<tr>
<td>Hematocrit (HCT)</td>
<td>Measures how much of a given volume of whole blood is made up of red blood cells — people with anemia have a low level</td>
<td>Men: 41 percent to 50 percent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Women: 35 percent to 46 percent</td>
</tr>
<tr>
<td>Mean corpuscular volume (MCV)</td>
<td>Measures the average size of red blood cells — a high level means they’re bigger than normal and a low level means that they’re smaller than normal</td>
<td>76 to 100 cu µm</td>
</tr>
<tr>
<td>White blood cell (WBC) count</td>
<td>Measures the number of white blood cells in your blood sample</td>
<td>4.5 to 10 thousand cells/mcL</td>
</tr>
<tr>
<td>Platelet (thrombocyte) count</td>
<td>Measures the number of platelets in your blood sample</td>
<td>150 to 450 thousand/mcL</td>
</tr>
</tbody>
</table>

*Varies in different clinics or hospitals and in different parts of the country.*
Appendix B: AML Classification Systems

It’s important to know your AML subtype because it plays a large part in determining the type of treatment you’ll receive. Doctors often use one of two systems to classify subtypes:

- World Health Organization (WHO) classification system
- French, American, British (FAB) system (not used much anymore)

**WORLD HEALTH ORGANIZATION (WHO) CLASSIFICATION SYSTEM**

In 1999, the World Health Organization (WHO) developed a new classification system, which incorporated information about cytogenetics to determine prognostic subgroups that may help define treatment strategies. This system was updated in 2016.

AML Subtypes Based on the WHO Classification

**AML with recurrent genetic abnormalities**

- AML with translocation between chromosomes 8 and 21
- AML with translocation or inversion in chromosome 16
- AML with translocation between chromosomes 9 and 11
- APL (M3) with translocation between chromosomes 15 and 17
- AML with translocation between chromosomes 6 and 9
- AML with translocation or inversion in chromosome 3

**AML (megakaryoblastic) with a translocation between chromosomes 1 and 22**
AML with myelodysplasia-related changes

AML related to previous chemotherapy or radiation
- Alkylating agent-related AML
- Topoisomerase II inhibitor-related AML

AML not otherwise categorized
(does not fall into above categories - similar to FAB classification)
- AML minimally differentiated (M0)
- AML with minimal maturation (M1)
- AML with maturation (M2)
- Acute myelomonocytic leukemia (M4)
- Acute monocytic leukemia (M5)
- Acute erythroid leukemia (M6)
- Acute megakaryoblastic leukemia (M7)
- Acute basophilic leukemia
- Acute panmyelosis with fibrosis

Myeloid Sarcoma (also known as granulocytic sarcoma, chloroma or extramedullary myeloblastoma)

Undifferentiated and biphenotypic acute leukemias (also known as mixed phenotype acute leukemias)
FRENCH, AMERICAN, BRITISH (FAB) SYSTEM

This is an older system that is not used much anymore. AML cells may have features of red cells, platelets or white cells in addition to myeloblasts or promyelocytes. AML subtypes M0 through M5 start in early white cells, subtype M6 starts in early red cells while subtype M7 starts in early platelet cells.

AML subtypes based on the FAB classification

<table>
<thead>
<tr>
<th>FAB Subtype</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>AML minimally differentiated</td>
</tr>
<tr>
<td>M1</td>
<td>AML with minimal maturation</td>
</tr>
<tr>
<td>M2</td>
<td>AML with maturation</td>
</tr>
<tr>
<td>M3</td>
<td>Acute promyelocytic leukemia</td>
</tr>
<tr>
<td>M4</td>
<td>Acute myelomonocytic leukemia</td>
</tr>
<tr>
<td>M4 eos</td>
<td>Acute myelomonocytic leukemia with eosinophilia</td>
</tr>
<tr>
<td>M5</td>
<td>Acute monocytic leukemia</td>
</tr>
<tr>
<td>M6</td>
<td>Acute erythroid leukemia</td>
</tr>
<tr>
<td>M7</td>
<td>Acute megakaryoblastic leukemia</td>
</tr>
</tbody>
</table>
15 Questions to Ask Your Doctor

About AML

1. What kind (subtype) of AML do I have?
2. How serious (severe) is my AML?
3. Tell me about patients who had AML like mine. How did they do?
4. Could my AML be related to other diseases or treatments I have had?

About treatment

5. What are all of my treatment options?
6. Which treatment do you recommend for me? Why?
7. What's the goal of the treatment?
8. How long will the treatment take to work? When will I know if it is working?
9. Could my AML come back even if treatment works?
10. Is this treatment covered by insurance?

About medicines

11. How is the medicine or treatment given (how do I take it)? How often?
12. How long will I need to stay on this medicine?
13. What side effects can this medicine have?
14. How can I deal with side effects?
15. Is this medicine covered by my insurance?
Many FREE services and programs are available to anyone impacted by, or just interested in, bone marrow failure diseases:

• **Personalized Support** from Information Specialists at (800) 747-2820 or help@aamds.org

• **Educational Materials** on diseases and treatments at www.aamds.org/materials

• **Global Educational Materials** in Spanish, French, German and Portuguese at www.aamds.org/global-education

• **The Online Academy** with 90+ live and recorded educational classes and much more at www.aamds.org/learn

• **Patient and Family Conferences** connecting patients with professionals and building community with each other at www.aamds.org/conferences

• **Print and Electronic Newsletters** with the latest news in treatment and research

• **Clinical Trials Information** at www.aamds.org/clinicaltrials

• **Peer Support Network** staffed by specially-trained volunteers who listen and offer guidance at www.aamds.org/support-networks

• **Community Connections** support groups run by volunteers for fellowship and support

AAMDSIF relies on its growing team of local Ambassadors – volunteers who contribute their time and talent in many ways, such as becoming:

• **Online Supporters** who hold digital fundraisers in their community or workplaces

• **Event Organizers** who plan “March for Marrow” fundraising walks or other events

• **AwarenessCampaigners** who teach their community about bone marrow failure

• **Community Connection leaders** who coordinate local patient support groups

Learn more about volunteering at ambassadors@aamds.org or (301) 279-7202 x122.