



# **Allogeneic Related Donor Information for Stem Cell Transplant**

**2021 Edition**



# **Allogeneic Related Donor Information for Stem Cell Transplant**

**2021 Edition**



## **Table of Contents**

### **Introduction**

### **HLA Typing**

### **Donor Testing and Collection**

Matched Related Donor (MRD) and Half-Matched (HAPLO) Related Donor

Related-Donor Pretesting

Mobilization

Harvesting of Peripheral Stem Cells

Harvesting From the Bone Marrow

Frequently Asked Questions

### **Transplant Day**

The Infusion

After the Infusion

### **Donor Lymphocyte Infusion (DLI)**

### **Glossary**



## INTRODUCTION

If you are reading this book, your family member is being considered for an ***allogeneic blood and marrow transplant***, or “BMT,” at Cedars-Sinai.

“**Bone marrow transplant**,” and “**peripheral blood stem cell transplant**” all refer to similar procedures that use cells collected in different ways. We will refer to both of these types of transplants using the term hematopoietic (blood-forming) ***stem cell transplant (SCT)***.

You are considering a donation of stem cells to your relative. To safely recover from high-dose ***myeloablative chemotherapy*** (and sometimes ***radiation***), your relative’s ***bone marrow*** must be “rescued” with healthy stem cells. This is the purpose of the SCT. The healthy stem cells need to be donated from someone else. This person is you. A transplant doctor, ***SCT nurse navigator (“navigator”)*** and nurses will teach you all you need to know about being a donor.

## HLA TYPING

### Human Leukocyte Antigen or “HLA” Typing

**HLA** refers to proteins that live on the surface of **white blood cells**. The proteins help your immune system recognize which cells belong inside your body (“self”) and which cells do not (“non-self”). Thus, even if you are related, your immune system is different from your relative’s.

Think of HLA typing like a fingerprint on the surface of cells inside a person’s bone marrow. It has nothing to do with their **blood type**. The HLA system is very diverse with over a quintillion different possible protein combinations! Everyone’s unique combination is inherited. Half of everyone’s typing comes from their mother and the other half from their father.

HLA testing is how we find a donor for an **allogeneic** BMT. The test requires a blood sample and sometimes a swab of the cheek. Potential donors also give a blood sample, and their results are compared to the relative who is being considered for an **SCT**. A suitable donor has the same, or almost the same, HLA “fingerprint” (HLA typing) as the relative/patient.

An ideal donor’s HLA “fingerprint” will have a “10 out of 10” match with the transplant patient. However, there has been success with transplants that are “half matched” (**haploidentical**) from related donors.

Once the HLA Lab receives the blood, results take 7-10 business days to process. The search process can take a while, and sometimes it may feel as though nothing is happening. Rest assured, your SCT coordinator will be checking for results and notifying your relative immediately when they come back. If you would like an update on the status of the HLA results, please reach out to your SCT navigator for an update at any time.

## DONOR TESTING AND COLLECTION

### Matched Related Donor (MRD) and Half-Matched (Haploidentical) Related Donor

Whether you are a “matched related donor” (an ideal perfect match) or a “half- matched” (**Haplo**) related donor, you may donate stem cells for your relative’s SCT.

Each person has a 25% (1 in 4) chance of matching with a sibling that has the same mother AND father as the patient. However, patients have a 50% (1 in 2) chance of half-matching with a parent or child.

Imagine rolling dice and one of the chances is an HLA match. If you have four siblings, you get to roll the dice four times. If you have three siblings, you get to roll three times, etc. With each roll you have a 25% (1 in 4) chance of finding a 100% match. In the case of a parent or child donor, with each roll you have a 50% (1 in 2) chance of finding a 50% match.

There are **two options** for HLA typing as a potential donor:

#### 1. You may come to Cedars-Sinai

A SCT **nurse navigator** will give you a doctor’s order to have blood drawn at a Cedars-Sinai outpatient laboratory. There is no charge for this service.

**OR**

#### 2. You may have your blood drawn at a local lab or doctor’s office

A SCT RN navigator will FedEx® empty blood tubes, a doctor’s order and instructions to the address you provide. A prepaid FedEx® envelope is included to return the blood to Cedars-Sinai for testing.

There may be a fee charged by local labs/offices for drawing the blood. We recommend you ask about fees prior to having their blood drawn, as insurance never covers these costs.

**It is very important that you provide the legal full name as it appears on your identification, date of birth, address and phone number.** Samples returned by mail must have the full name, date of birth, and date the blood was drawn labeled on the blood tube.

Missing or inaccurate information may result in the blood sample being thrown away and will delay identifying your donor!

Once a match is identified, insurance authorization for your relative’s transplant will be requested.

The transplant authorization covers the required testing and procedures for you as a donor. You do not have to have your own medical insurance in order to donate for your relative.



## Related-Donor Pretesting

Your related-donor testing will be done at Cedars-Sinai. It takes about four hours to complete and includes:

- **History and physical with an SCT doctor.** The SCT doctor will not be the same as your relative's SCT doctor. This is to ensure that you have a doctor acting on your behalf, not one that already has a relationship with your relative. Questions about your health, travel and lifestyle will be asked. This is part of the screening for infectious diseases.
- **Informed consent.** Your relative, the patient, is not permitted to attend this appointment. It is a private discussion between you and your SCT doctor. The risks and benefits of donating will be explained to you. You will have an opportunity to ask questions. Donating **stem cells** for your relative is your choice. The doctor will move forward if you agree to the procedure, you meet medical clearance and sign the consent forms.
- **Chest X-ray.** Standard procedure to look for abnormalities in the heart, lungs and chest.
- **Electrocardiogram (EKG).** To measure electrical activity inside the heart.
- **Blood and urine testing.** Testing for a variety of infectious diseases such as HIV, **hepatitis** and other **viruses** will be done in the blood donor facility. A **complete blood count** and **chemistry panel** will also be drawn to evaluate basic organ function.
- **Donor education.** Your navigator will ensure you understand the process and schedule for donating stem cells. You may contact the navigator anytime if they have further questions.

Sometimes donors have a medical condition that would normally exclude them from donating. The SCT doctor will decide whether medical necessity outweighs the risks involved in using you as a donor.

When all the results are reviewed and you have signed the consent to donate, your relative's admission to the hospital will be scheduled. Usually, their **conditioning regimen** begins before your stem cell **mobilization** and collection (**harvesting**) of peripheral stem cells.

Another way to collect or harvest stem cells is to take them directly from the bone marrow. This is explained later.

## Mobilization

Mobilization is the process of using medications called **growth factors** to move stem cells from the **bone marrow** and into the circulating blood.

The growth factor medication used to move the stem cell from the bone marrow to the blood is called Neupogen® (GCSF). It is given as a small **subcutaneous injection** under the skin. This is called "**Mobilization**." This medication is given for five days in a row in the Cancer Center. On the fifth day, stem cell collection takes place. The main side effect from Neupogen® is bone pain. You can take Claritin® or Allegra® on days you are getting growth factors, which may reduce the bone pain.

Other side effects include:

- Low-grade **fever**
- Left-side abdominal pain. This is a very rare complication that needs to be reported right away to your nurse or doctor as it could indicate a problem with the spleen.

## Harvesting of Peripheral Stem Cells

**Stem cells** are collected from your circulating blood. These are called **peripheral bloodstem cells** or PBSCs. On collection day, you will come to the Cancer Center first for Neupogen®. Then, a special IV line must be placed.

There are two possible ways to collect PBSCs:

1. Two needles (one in each arm) are placed into the vein right below where the arms bend at the elbow. This is the same vein that is used for a whole blood or platelet donation. This method may only be used for donors that have very good veins and can sit for four hours without bending their arms.
2. A special IV line called an **apheresis catheter** or **internal jugular (IJ)** is placed into the large vein (internal jugular vein) inside the donor's neck. One type is called "**Mahurkar**." The line is held in place by a suture and a sterile dressing. This may feel uncomfortable due to its location on the neck. This will only be required until stem cell collection is complete.

Things to know:

- This **IJ** catheter allows us to **harvest** cells from the circulating blood. It is placed in the Cedars-Sinai Procedure Center by a specially trained doctor with the assistance of specially trained nurses.
- The area is numbed prior to insertion. Your donor will feel pressure but usually not pain when it goes in.
- Once it is in place, you are able to eat, sleep, read or do other quiet activities while your stem cells are being collected.
- The IJ will be removed as soon as the collection is complete—one to two days.

If you are claustrophobic or anxious about the IJ, the doctor may prescribe medication to help you relax. Once the IJ is placed, an X-ray will be done to make sure it is positioned correctly. The stem cell collection nurses will assess your veins. In some cases, you will get to decide which collection method you would prefer to have.

The process of harvesting stem cells is called **apheresis** and takes place in the Rita and Taft Schreiber **Blood Donor Facility**.

Each session on the apheresis machine is four to five hours long. During that time, you are resting in bed and the nurse will be monitoring you. You may sleep, eat, watch TV or do other quiet activities.

The apheresis machine looks like a cross between a kidney dialysis machine and a washing machine on spin cycle.

### Apheresis works like this:

1. Blood exits the body through one side of the IJ.
2. It travels through a machine that spins the blood so fast that it separates into different parts.
3. The stem cells are removed and collected into a bag hanging above the machine.
4. The rest of the blood is returned to you through the other side of the line.

All of this happens simultaneously: blood comes out, stem cells removed, blood is returned.

Things to know:

- The bags and tubing are sterile and discarded after each donor. Blood never comes into direct contact with any part of the **apheresis** machine.
- There is no risk of contracting any bloodborne illness from apheresis.
- Every drop of blood in the body travels through the tubing in the apheresis machine three to four times. This maximizes the number of stem cells collected.
- You cannot be disconnected from the machine to use the restroom. A urinal, bedpan and commode are available.

For most donors, the main side effect of apheresis is boredom. However, quiet activities are allowed. The following side effects are also possible:

- **Tingling around the lips and fingers.** This may occur because the anticoagulant being used combines with the calcium in your body. To prevent these symptoms, a calcium IV drip will be running continuously during the stem cell collection.
- **Discomfort.** Sometimes donors find it uncomfortable to lay in bed for four to five hours. **Growth factors** can cause bone pain, which adds to this discomfort. Tylenol<sup>®</sup> can help alleviate this.

If you experience any of the side effects listed above, or feel anything different, you should make sure to let the apheresis nurse know right away.

At the end of each collection day, the SCT navigator will receive the stem cell count. Once enough cells are collected, your IJ line will be removed. At that point, the stem cell collection is complete. You may resume normal work and activities the following day.

### Harvesting From the Bone Marrow

**Bone marrow harvesting** is a surgical procedure that takes place in the Cedars-Sinai operating room. Sometimes, the bone marrow is harvested in a hospital closer to the donor's home.

#### Harvesting in the operating room works like this:

1. You are put under **anesthesia** during the procedure.
2. Bone marrow is pulled out by a needle and syringe placed into the back of the pelvic bone, near the hip.

3. To get enough stem cells, multiple aspirations must be taken, until 1-2 quarts have been collected. It sounds like a lot, but actually it is only 2-5% of a person's bone marrow. You will regenerate those cells within one month. When you wake up, you may have some discomfort in your lower back. The pain is generally mild and can usually be relieved with Tylenol®.
4. There will be several puncture wounds from where the needle was inserted, but no stitches or surgical incisions. You may resume normal activity within a couple of days.

You are usually discharged after recovering in the post-anesthesia care area. The back of the pelvic bone will have a large dressing on both sides. If needed, you can be admitted to the hospital for overnight observation.

Common side effects of marrow donation usually last only a few days. They include back or hip pain, fatigue, throat pain and/or muscle pain. Less frequently, donors report insomnia, headache, dizziness and loss of appetite.

(Source [bethematch.org/support-the-cause/donate-bone-marrow/donation-process/donating-bone-marrow/](http://bethematch.org/support-the-cause/donate-bone-marrow/donation-process/donating-bone-marrow/))

**There are advantages and disadvantages to receiving a marrow product or a PBSC product.**

The BMT doctor will decide which type of stem cell is preferred for your relative's transplant. You, the donor, with the advice of your doctor, will decide if you are willing to give what is asked. In most cases, we will accept either product.

## Frequently Asked Questions

### Am I too old to donate?

Age may be a factor in determining whether a donor may donate. Donor testing results and overall health will determine if you are eligible.

### What if I have a preexisting medical condition?

All preexisting medical conditions will be considered on a case-by-case basis. The SCT doctor will determine whether or not you are healthy enough to safely donate **stem cells**. Some medical conditions do not increase the risk of donating at all (examples: diabetes, high blood pressure), while others would make you ineligible to donate (examples: HIV, cancer).

### Will donating stem cells hurt?

The procedures to collect stem cells are generally well-tolerated and painless. There are minimal risks when donating **peripheral blood stem cells**. Bone pain is the most common complaint. Your BMT doctor may recommend medications to relieve such pain. Mild discomfort may also be experienced from the special IV lines used during peripheral stem cell collection. Donating bone marrow in the operating room also has risks associated with general anesthesia.

Most donors resume normal activities the day after donation.

### **Can I do anything to make my stem cells stronger and improve my relative's transplant**

Unfortunately, no. Relative donors cannot do anything to improve the outcome of the transplant. There are many factors that contribute to the success of a transplant: the patient's diagnosis, the stage of disease, age and overall health.

### **What if I do not have medical insurance?**

Once we receive authorization for your relative's transplant, their insurance covers the donor's medical costs related to your transplant. This includes their HLA typing, donor testing, stem cell **mobilization** and stem cell collection. You will not need medical insurance to donate for your relative.

### **What if I live in another state/country?**

Your RN navigator will help facilitate visa applications for you from other countries to travel to the U.S for donation. We will also work together with you to schedule appointments and stem cell collection. Application fees and travel costs (including flights) for you are usually not covered by your insurance.

### **Are there other costs that insurance does not pay for?**

Costs that are not covered include but are not limited to: loss of salary due to missed work, hotel and transportation costs, personal expenses and fees charged by outside labs for drawing the sample for initial HLA testing.

### **What if I am unavailable during the time my relative needs the transplant?**

If you cannot be in Los Angeles for the preferred date for your relative's transplant, we may collect your stem cells early and freeze (**cryopreserve**) them. They are placed into a freezer in the Stem Cell Lab until your relative needs them for transplant.

### **What if I am pregnant?**

We cannot mobilize stem cells or harvest them if you are or become pregnant.

### **What if my relative (the patient) and I do not get along?**

Because stem cell donation is voluntary, you must decide if you are willing to participate. There are many emotions involved in stem cell donation between relatives. It can bring people closer together, but it also has the potential to pull people further apart. It is up to you and your relative to decide what to do. The SCT medical social worker is available to assist with issues related to patient/donor relationships. Please speak with your SCT navigator and/or doctor about any concerns you have about donating.

### **Will my relative become more like me after transplant?**

Yes and no. The patient's personality will not become more like yours after SCT. However, the relative, or recipient, will have your DNA inside their **bone marrow** and will likely convert to your blood type.

## TRANSPLANT DAY

Here is what your relative can expect on **transplant** day, also called “day zero.”

### The Infusion

- The cells will be delivered to your relative’s room just after they have been received, inspected, washed (if your relative’s **blood type** is not compatible with yours), counted and tested. The color inside the bag may range from light candy red to dark red, like blood. If the cells were frozen, they will be thawed in the Stem Cell Lab.
- A nurse will be present throughout the transplant infusion and monitor your relative.
- The stem cells are infused into a peripherally inserted central catheter (**PICC**) line much like a blood transfusion. The infusion will not hurt.
- Each bag is infused one at a time over 20 minutes to several hours.
- Most patients do not experience discomfort during their stem cell infusion. Your relative most likely feel tired from the pre-medications.

### After the Infusion

The donor cells will find their way from the bloodstream and into your relative’s **bone marrow**. Once they get there, they are like seeds planted in the earth; they just need time to grow. When they do, they will begin the process of making new blood cells and slowly rebuilding your relative’s blood and immune system. This is called **engraftment**.

## DONOR LYMPHOCYTE INFUSION (DLI)

If your relative's disease comes back after transplant, they may need a donor lymphocyte infusion or "DLI." Sometimes a DLI is used to boost the donor graft when chimerism studies show low donor DNA in your blood.

Lymphocytes are immune system cells that can attack leukemia. Think of a donor lymphocyte infusion as an immune system boost.

Donor lymphocytes are collected and infused just like they were for the SCT. You, the donor, will be asked to donate again for your relative. Sometimes relative's donor lymphocytes are collected prior to SCT and frozen for potential future use.

There is no medication required to "**mobilize**" the lymphocytes. The cells are collected from a large vein in the arm. Blood is removed from you, the donor, via a needle in one arm, the lymphocytes are siphoned off, and the rest of the blood is returned via a needle in the other arm.

The hope is that a war will begin between the lymphocytes and your relative's **cancer** cells shortly after a DLI. This happens if the lymphocytes see the cancer cells as foreign invaders (like bacteria) and attempt to destroy them. These phenomena are called "graft-versus-leukemia" or "GVL."

## GLOSSARY

If you have any questions regarding these terms or anything about the written information given to you, please ask us. Some of the words in this glossary are not mentioned in the book, but you may hear them while going through your transplant.

***Allogeneic stem cell transplant:*** A type of bone marrow transplant where transplanted bone marrow comes from a compatible donor other than the patient. The donor could be a sibling, an unrelated person or an unrelated umbilical cord.

***Anesthesia:*** The absence of normal sensation and pain due to medications, such as those used during surgery.

***Apheresis:*** A method of obtaining blood stem cells for transplantation. The donor's blood is circulated through a machine, a little at a time, to collect the stem cells. The patient's total blood volume circulates through the machine several times to collect as many stem cells as possible. All the other blood components are returned to the donor.

***Apheresis catheter or "IJ":*** An intravenous line that is placed for the purpose of apheresis. It is placed in the side of the neck, where it is tunneled under the skin and into the internal jugular vein above the heart. It has two "lumens" (tubes), so that blood can flow out from one lumen and return by the other lumen.

***Blood and marrow transplant (BMT):*** A treatment used for cancer and certain other diseases. The patient receives very high doses of chemotherapy, with or without radiation therapy, in order to destroy the disease. The patient's own bone marrow, which is destroyed during the therapy, is replaced by a transfusion of stem cells collected from either the patient or from a compatible donor. The stem cells are infused to help the patient's body make blood cells and grow a healthy immune system.

***Blood Donor Facility:*** A clinic that specializes in blood donation and apheresis.

***Blood type:*** The description of a person's blood based on the presence or absence of "antigens" on the cell surfaces of the red blood cells; these are A, B, AB, O and Rh negative or Rh positive.

***Bone marrow:*** The inner, spongy tissue of bones where red blood cells, white blood cells and platelets are made.

***Bone marrow harvesting:*** The collection of marrow from the posterior iliac crests of the pelvis via multiple punctures with a large needle and aspiration of bone marrow. This is normally done with the donor under general anesthesia in the operating room.

***Cancer:*** Any malignant (abnormal, spreading) cellular tumor or growth.

***Cell(s):*** The basic building blocks of all living things. The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.

***Chemotherapy:*** Treatment of disease, usually cancer, by chemicals/medications; not all chemotherapy drugs are derived from true "chemicals" but are originally derived from natural substances. An example is Taxol®, which was originally derived from the bark of the yew tree.



**Chemistry panel:** A blood test to determine the function of various organs such as your liver and kidneys; it looks at your electrolytes, minerals and other values.

**Chest X-ray:** An X-ray to evaluate chest structures such as the heart and lungs.

**Complete blood count (CBC):** A blood test to count the red blood cells, white blood cells and platelets.

**Conditioning regimen:** A term used for the therapy, given to prepare the patient's body for blood and marrow transplant. The regimen generally lasts 2 to 10 days prior to the transplant. Also known as the preparative regimen.

**Cryopreserve (cryopreservation):** Methods used to prepare either bone marrow or peripheral blood stem cell products for freezing and long-term storage and prevent cell destruction during either the freezing or thawing process. The addition of 10% DMSO (dimethyl sulfoxide) to the product is the most common approach. The product is then stored in liquid nitrogen.

**EKG (electrocardiogram):** A test to evaluate the electrical conduction of your heart.

**Engraft (engraftment):** The point at which there are >1000 white blood cells per microliter or an ANC >500; >20,000 platelets (or platelet independence).

**Fever:** The rising of a person's temperature above normal, which is generally 98.6 degrees. A fever is usually a symptom of an infection or an allergic reaction. If you are neutropenic, even a "low-grade" fever (such as 100.4 degrees) is significant.

**Growth factors:** A medication that stimulates the growth and development of certain cells. GM-CSF and G-CSF are growth factors that stimulate certain white blood cells, including neutrophils.

**Haploidentical ("Haplo") transplant:** A type of allogeneic transplant that uses healthy stem cells from a half-matched donor to replace the patient's marrow. The donor is usually a family member.

**Harvest (harvested):** See "bone marrow harvesting" or "apheresis."

**Hepatitis panel:** A blood test to determine if a person has been exposed to hepatitis viruses.

**Human leukocyte antigen (HLA typing):** A test that determines the type of markers you have on certain tissues and cells, including platelets, that allow your body to know "self" from "non-self."

**IJ or internal jugular catheter:** See "apheresis catheter."

**Informed consent:** The written or verbal approval for a treatment that has been fully described, including risks and benefits.

**Mahurkar:** A type of **apheresis catheter**. It is a temporary large venous line that has two tubes used for apheresis. It is usually placed directly into the jugular vein in the lower neck area.

**Mobilize (mobilization):** The process of stimulating stem cell growth and movement from the bone marrow to the peripheral blood. This can be done by growth factors with or without chemotherapy.

**Myeloablative:** Cancer treatment (chemotherapy and sometimes radiation) that destroys the bone marrow beyond its ability to ever recover function.

**Peripheral blood stem cells:** See “stem cells.”

**Peripherally inserted central catheter (PICC):** A catheter that is inserted into a large vein in your arm. It is threaded so that the tip of the catheter is in a large vein near your shoulder, close to the upper-right chamber of your heart. Medications, blood products and IV fluids can be given through the catheter.

**Radiation or radiation therapy:** Treatment of disease by means of ionizing radiation. Ionizing radiation is high-intensity X-rays.

**SCT nurse navigator (“navigator”):** A registered nurse who specializes in blood and marrow transplant. Their role is to help teach the patient and family, and coordinate care prior to transplant.

**Stem cells:** The cells from which all blood cells develop. Most are in the bone marrow. However, there are very small amounts in the blood of normal individuals.

**Stem cell collection (stem cell harvesting or stem cell apheresis):** See “apheresis.”

**Stem cell transplant (SCT):** Transplantation of blood-forming (hematopoietic) stem cells from blood or bone marrow.

**Subcutaneous injection:** An injection, or shot, of medication that is given by a very thin needle just under the skin. The medication is absorbed into the bloodstream over a short amount of time.

**Transplant:** To transfer an organ or tissue from one donor to another. See “allogeneic transplant” and “autologous transplant.”

**Virus (viruses):** An extremely tiny parasite that can only reproduce if it is within a living being, or anything that corrupts something else. An example of a **virus** is the herpes simplex virus that produces cold sores or small blisters that develop on the lips or mouth.