

Myelodysplastic Syndromes

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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 explains which cancer tests and treatments are recommended by experts in myelodysplastic syndromes.

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 myelodysplastic syndromes. 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 myelodysplastic syndromes. Key points of the book are summarized in the [NCCN Quick Guide™](#). NCCN also offers patient resources on chronic myelogenous leukemia, chronic lymphocytic leukemia, acute lymphoblastic leukemia, and other cancer types. Visit [NCCN.org/patients](https://www.nccn.org/patients) for the full library of patient books, summaries, and other resources.

About



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 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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Aplastic Anemia and MDS International Foundation

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

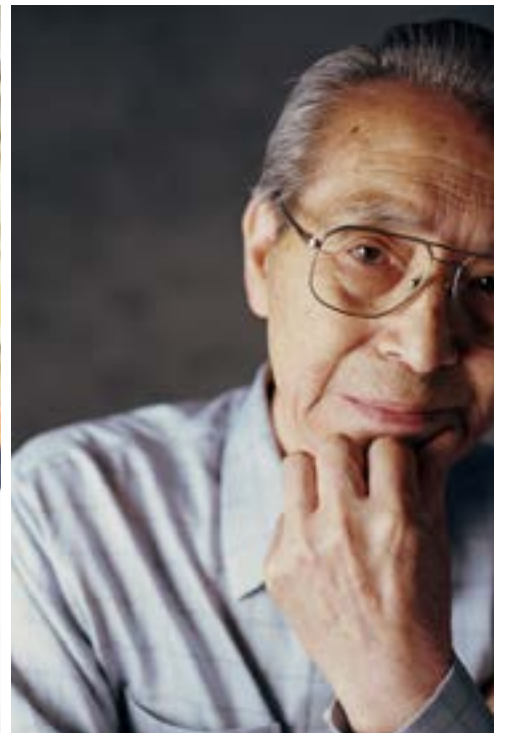
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MDS Foundation, Inc.

The MDS Foundation, Inc. is pleased to endorse the NCCN Patient Guidelines: Myelodysplastic Syndromes (MDS) as an instrumental resource to MDS patients and caretakers. Providing a guide in a patient friendly format offers patients access to understandable information and knowledge to assist them in making important decisions about their care. www.mds-foundation.org.

The Leukemia & Lymphoma Society (LLS)

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. www.LLS.org/InformationSpecialists.



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Who should read this book?

The information in this book is about myelodysplastic syndromes—a group of cancers in which the bone marrow doesn't make enough healthy, mature blood cells. Patients and those who support them—caregivers, family, and friends—may find this book helpful. It may help you discuss and decide with your doctors what care is best.

Are the book chapters in a certain order?

Starting with **Part 1** may be helpful for many people. It explains what myelodysplastic syndromes are. Knowing more about this group of cancers may help you better understand the treatment options.

Parts 2 and 3 explain how doctors assess for myelodysplastic syndromes and plan treatment. **Part 4** introduces types of treatments that may be used. **Part 5** is a guide to treatment options. **Part 6** offers some helpful tips for making treatment decisions and questions to ask your doctors.

Does this book include all options?

This book includes information for many situations. Your treatment team can help. They can point out what information applies to you. They can also give you more information. As you read through this book, you may find it helpful to make a list of questions to ask your doctors.

The recommendations in this book are based on science and the experience of NCCN experts. But, these recommendations may not be right for your situation. Your doctors may suggest other tests and treatments based on your health and other factors. If other recommendations are given, feel free to ask your treatment team questions.

Help! What do the words mean?

In this book, many medical words are included. These are words you will likely hear from your treatment team. Most of these words may be new to you, and it may be a lot to learn.

Don't be discouraged as you read. Keep reading and review the information. Feel free to ask your treatment team to explain a word or phrase that you don't 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*. One example is MDS for **myelodysplastic syndromes**.

1

Myelodysplastic syndromes

8 The blood cells

9 MDS basics

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You've learned that you have or may have MDS (**myelodysplastic syndromes**). Part 1 explains some basics about this cancer that may help you learn about it and start to cope. This information may also help you start planning for treatment.

The blood cells

Blood is made up of a combination of cells and fluid, which is mostly water. The cells in the body are divided into three main types:

- ▶ Platelets help control bleeding.

- ▶ Red blood cells carry oxygen throughout the body.
- ▶ White blood cells help fight germs and infections.

Each type of blood cell has a different job. Blood cells grow up in the bone marrow, which acts like a garden in which cells grow from the youngest cell type (which exist in small numbers) to adult cells (which are ready to be born) and do their proper jobs. Bone marrow is the soft tissue in the center of most bones. **See Figure 1.** The most immature blood-forming cells are called stem cells or hematopoietic stem cells. Blood stem cells have the potential to become any type of mature blood cell.

Figure 1 Blood cells in bone marrow

Bone marrow is the soft, sponge-like tissue in the center of most bones. Blood stem cells in the bone marrow make all types of blood cells.

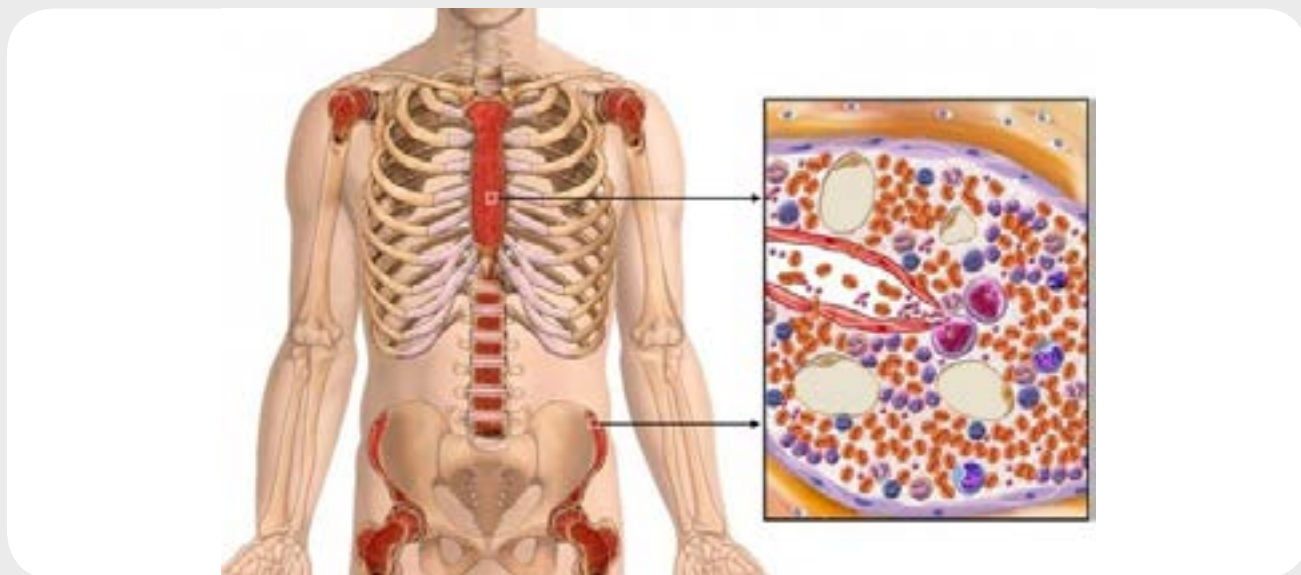


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Blood stem cells go through a series of changes as they grow and develop into new blood cells. Blast cells are new, very young (immature) blood cells that grow into adult (mature) blood cells over time. Once they mature even a little, blast cells commit to become specific different types of mature blood cells. When they become completely mature, the blood cells leave the bone marrow and enter the bloodstream.

MDS basics

Cancer is a disease in which normal cells stop following the rules that let them grow up. MDS is

a group of cancers that affect blood cells in the bloodstream and bone marrow. MDS starts in the blood-forming cells (blood stem cells) of the bone marrow.

Normal blood stem cells grow and then divide to make new red blood cells, white blood cells, and platelets as the body needs them. Normal red blood cells live for 3 months, normal white blood cells (neutrophils) live for 8 to 14 days, and normal platelets live about a week. After the cells reach these ages, they die off and are replaced with new cells that are born from the bone marrow. If the cells are damaged, they die. New blood cells are then made to replace the old ones.

Figure 2 Chromosomes and genes in cells

Genes are coded instructions in cells for making new cells and controlling how cells behave. Genes are a part of DNA, which is bundled into long strands called chromosomes. Every cell has 23 pairs of chromosomes.

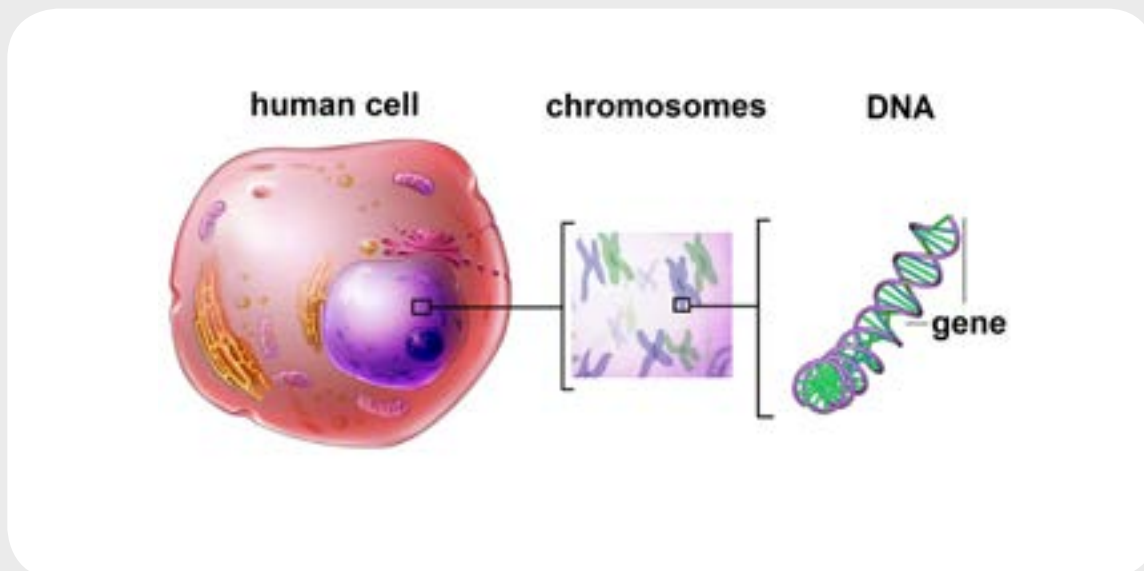


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Inside of all cells are coded instructions for building new cells and controlling how cells behave. These instructions are called genes. The instruction for different genes is stored in the body in the form of DNA (**d**eoxyribonucleic **a**cid). The DNA in our bodies is organized into long strands called chromosomes. **See Figure 2.** Changes (mutations) in genes can cause normal cells to become cancer cells. It is not known what exactly causes the genes to change.

MDS happens when changes in genes cause blood stem cells to become abnormal. This damages the blood stem cells and bone marrow so they don't work as well as they should. The abnormal blood stem cells have trouble making enough new blood cells for the body. They also make new blood cells that are abnormal (defective).

The defective blood cells are different from normal blood cells in a few key ways:

- The cells have an abnormal size, shape, or look (appearance). This is called dysplasia.
- The cells do not grow into normal, mature blood cells and do not leave the bone marrow, as they should.
- The cells may die too early in the bone marrow or soon after they enter the bloodstream.

Because of this damage, the bone marrow isn't able to make enough healthy blood cells that the body needs. The defective cells can build up and overcrowd the bone marrow. As a result, even fewer healthy blood cells may be made or survive. This leads to a low number of red blood cells, white blood cells, and/or platelets in the bloodstream.

MDS may continue to get worse over time. In some cases, it may progress to a fast-growing (aggressive) cancer called AML (**a**cute **m**yeloid **l**eukemia). This can happen as more and more blast cells fill up the

bone marrow. About a third of patients (1 out of 3) with MDS, who have other biological factors, may develop AML.

Types of MDS

MDS is divided (classified) into groups based on features of the bone marrow and blood cells. These groups are also called subtypes. There are two systems that are used to classify MDS.

The first one was created in 1982 and is called the FAB (**F**rench-**A**merican-**B**ritish) classification system. The FAB system groups MDS into five subtypes. This system is not used much today. The newer one is called the WHO (**W**orld **H**ealth **O**rganization) classification system. The 2016 Revision to the WHO system groups MDS into seven main subtypes. The WHO system also has a category called MDS/MPN (**m**yelodysplastic **s**yndromes/**m**yeloproliferative **n**eoplasms) with four other subtypes.

The WHO system is most commonly used today. Most doctors use this system to diagnose MDS and classify the different MDS subtypes. The main factors that are used to define MDS subtypes in the WHO system include:

- The type and number of low blood cell counts (cytopenias).
- Which and how many types of blood cells in the bone marrow have an abnormal size, shape, or look (dysplasia).
- The number of blast cells found in the blood and bone marrow.
- The types of chromosome changes seen in bone marrow cells.

- ▶ The presence of red blood cells that have too much iron (ring sideroblasts).

MDS subtypes in the WHO classification system

MDS-UD (MDS with unilineage dysplasia)

In this subtype, there is a low number of one type of blood cells in the bloodstream. The same type of blood cell looks abnormal in the bone marrow. For the affected cell type, at least 10 percent of the cells look abnormal (show dysplasia). No blast cells are found in the bloodstream. Less than 5 percent of cells in the bone marrow are blast cells.

MDS-RS (MDS with ring sideroblasts)

In this subtype, there is a low number of red blood cells in the bloodstream. Red blood cells are also abnormal in the bone marrow. At least 15 percent of young red blood cells in the bone marrow are ring sideroblasts. Less than 5 percent of cells in the bone marrow are blast cells. No blast cells are found in the bloodstream. There is a normal number of white blood cells and platelets in the bloodstream and these cells look normal in the bone marrow.

MDS-MD (MDS with multilineage dysplasia)

In this subtype, there is a low number of one or more types of blood cells in the bloodstream. Two or more types of blood cells look abnormal in the bone marrow. Of the affected cell types, at least 10 percent of the cells look abnormal. Some young blood cells in the bone marrow may be ring sideroblasts. Overall, less than 5 percent of cells in the bone marrow are blast cells. No blast cells are found in the bloodstream.

MDS-EB1 (MDS with excess blasts-1)

In this subtype, one or more types of blood cells are low in the bloodstream and also look abnormal in the bone marrow. The number of blast cells is higher than normal. Less than 5 percent of cells in the bloodstream are blast cells. In the bone marrow, 5 percent to 9 percent of cells are blast cells.

MDS-EB2 (MDS with excess blasts-2)

In this subtype, one or more types of blood cells are low in the bloodstream and also look abnormal in the bone marrow. The number of blast cells is higher than normal. Five to 19 percent of cells in the bloodstream are blast cells and 10 to 19 percent of cells in the bone marrow are blast cells.

MDS-U (MDS, unclassified)

In this subtype, the features of the blood and bone marrow don't fit any of the other subtypes. One or more types of blood cells are low in the bloodstream, but less than 10 percent of that cell type looks abnormal in the bone marrow. Very few or no blasts are found in the bloodstream on at least 2 occasions and less than 5 percent of cells in the bone marrow are blast cells. Cells in the bone marrow have at least one abnormal chromosome change that is linked with MDS.

MDS associated with isolated del(5q)

In this subtype, cells in the bone marrow have only one abnormal chromosome change. This change is called del(5q), which means that part of chromosome 5 is missing (deleted). In some circumstances, one additional abnormal chromosome can be present. There is a low number of red blood cells in the bloodstream and the number of platelets is normal or high. Less than 5 percent of cells in the bone marrow are blast cells.

MDS/MPN subtypes in the WHO classification system

The MDS/MPN category includes subtypes that have both dysplastic and proliferative features. Dysplastic refers to the bone marrow making blood cells that look and act abnormal. Proliferative refers to the bone marrow making too many blood cells. The subtypes in the MDS/MPN category are described next.

CMML-1 (chronic myelomonocytic leukemia-1)

In this subtype, there is a high level of white blood cells called monocytes in the bloodstream. One or more types of blood cells in the bone marrow look abnormal (show dysplasia). Less than 5 percent of cells in the bloodstream are blast cells. Less than 10 percent of cells in the bone marrow are blast cells.

CMML-2 (chronic myelomonocytic leukemia-2)

In this subtype, there is a high level of monocytes in the bloodstream. One or more types of blood cells in the bone marrow look abnormal. In the bloodstream, 5 to 19 percent of cells are blast cells. In the bone marrow, 10 to 19 percent of cells are blast cells.

Atypical CML (chronic myeloid leukemia), BCR-ABL1 negative

In this subtype, there is a high level of white blood cells in the bloodstream. More than 10 percent of the cells are very young neutrophils. But, less than 20 percent of cells in the bloodstream are blast cells. There is a higher-than-normal number of blood cells in the bone marrow. Less than 20 percent of cells in the bone marrow are blasts. This subtype has cells that may look similar to CML when viewed with a microscope. But, the cells lack the chromosome and gene changes found in typical CML. The key changes in typical CML are the abnormal Philadelphia chromosome and the *BCR-ABL1* gene. This subtype is not treated the same as typical CML.

JMML (juvenile myelomonocytic leukemia)

In this subtype, there is a high level of monocytes in the bloodstream and bone marrow. Less than 20 percent of cells in the bloodstream are blast cells. This subtype is a lot like CMML. The main difference is that JMML most often occurs in young children.

MDS/MPN (MDS/myeloproliferative neoplasm), unclassifiable

This subtype is also referred to as “Overlap syndrome.” There is a high level of one or more types of blood cells in the bloodstream and bone marrow. One or more types of blood cells also look abnormal. But, the features of the blood and bone marrow don’t fit any of the other MDS/MPN subtypes.

MDS/MPN-RS-T (MDS/myeloproliferative neoplasm with ring sideroblast and thrombocytosis)

In this subtype, there is a high level of one or more types of blood cells in the bloodstream and bone marrow. At least 15 percent of young red blood cells in the bone marrow are ringed sideroblasts along with a platelet count.

Symptoms of MDS

People with MDS often have low levels of one or more types of blood cells in their bloodstream. A low number of blood cells is called a cytopenia. Most symptoms of MDS are caused by not having enough healthy red blood cells, white blood cells, or platelets in the bloodstream.

- Anemia is a very common condition that occurs because you have a low number of healthy red blood cells. Red blood cells carry oxygen throughout the body. A low number of red blood cells can cause symptoms such as extreme tiredness (fatigue), dizziness, weakness, shortness of breath, and pale skin.
- Neutropenia happens when you have a low number of healthy white blood cells. White blood cells help the body fight germs and infections. Thus, neutropenia can lead to frequent or severe infections.
- Thrombocytopenia happens when you have a low number of healthy platelets. Platelets help control bleeding and help wounds heal. A low number of platelets can cause symptoms such as easy bruising and bleeding.

Doctors will assess your health and learn about your symptoms. Keep in mind, symptoms of MDS can happen with other medical conditions. MDS is often a slow-growing cancer and some people with MDS have no early symptoms of disease. It is important to tell your doctor how you are feeling during your visit and call if you have any symptoms.

Review

- Blood cells are made in the soft tissue in the center of most bones called bone marrow.
- A blood stem cell is a cell from which all other types of blood cells are made.
- MDS is a group of cancers that affect blood cells in the bone marrow and bloodstream.
- In MDS, the bone marrow makes abnormal blood cells and doesn't make enough healthy, mature blood cells for the body.
- MDS is divided into smaller groups based on the features of the bone marrow and blood cells. These smaller groups are called subtypes.



When I was originally diagnosed with MDS, I was angry and hurt. I was wondering “why me?”, and “what have I done to deserve this?” Once those feelings subsided, I was scared of the unknowns and worried about treatments and being sick. I spent countless hours researching and praying. I am grateful for having a wonderful team of doctors and a very supportive family.

- Shaunna

2

Testing for MDS

- 15 Medical history
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Treatment planning starts with testing. This section describes the tests that are used to check for and confirm (diagnose) MDS. These tests also help doctors plan treatment. This information can help you use the *Treatment guide* in Part 5. It may also help you know what to expect during testing.

Medical history

Your medical history includes any health events in your life and any medicines you've taken. A medical history is needed for treatment planning. See [Guide 1](#) for a full list of the tests that are recommended before treatment for MDS.

Your doctor will ask about illnesses, injuries, and health problems that you have had. This includes any low blood cell counts (cytopenias) you have had. Your doctor will also ask about prior infections, abnormal bleeding, and the number of blood transfusions you've had.

Your doctor will also ask about any symptoms you've had that may be due to MDS. This information may affect which cancer treatment is best for you. It may help to make a list of old and new medicines while at home to bring to your doctor's office.

Guide 1. Tests used to diagnose MDS

Needed for most patients	May be needed for some patients
• Medical history and physical exam	• Copper level
• CBC (complete blood count) with differential	• HIV (human immunodeficiency virus) testing
• LDH (lactate dehydrogenase)	• HLA (human leukocyte antigen) typing
• Reticulocyte count	• Flow cytometry
• Blood smear	• FISH (fluorescence in situ hybridization)
• Serum EPO (erythropoietin)	• Molecular testing
• Iron, ferritin, folate, and vitamin B12	• Check for certain congenital (from birth) medical conditions
• Assess for thyroid problems	
• Bone marrow biopsy and aspiration	
• Cytogenetic testing	

Physical exam

Doctors usually perform a physical exam along with taking a medical history. A physical exam is a review of your body for signs of disease such as infection and areas of unusual bleeding or bruising.

Your doctor may listen to your lungs, heart, and intestines. Your doctor may also feel different parts of your body to see if organs are of normal size, are soft or hard, or cause pain when touched.

Blood tests

Doctors test blood to look for signs of disease and to check your general health. Blood tests are done along with other initial tests to help diagnose MDS. For a blood test, your doctor will insert a needle into a vein to remove a sample of blood. The blood sample will then be sent to a lab for testing. At the lab, a pathologist will examine the blood sample with a microscope and perform other tests.

CBC with differential

CBC is a test that measures the number of blood cells in a blood sample. It includes the number of white blood cells, red blood cells, and platelets. Patients with MDS often have a low number of one or more types of blood cells. A low number of blood cells is called a cytopenia.

The CBC should include a differential. The differential measures the different types of white blood cells in the sample. Some types of white blood cells include neutrophils, monocytes, and lymphocytes.

A CBC with differential is given with other tests when MDS is first suspected. This test is not used alone to diagnose MDS, but it can tell your doctor about your overall health. It will show if you have the right number of healthy red blood cells, white blood cells,

and platelets. It can also guide other tests that may be needed to find out why blood cell counts are low.

Reticulocyte count

Reticulocytes are younger (precursor) cells that become mature red blood cells. The reticulocyte count is a measure of the number of reticulocytes in the bloodstream. It reflects how quickly reticulocytes are being made and released by the bone marrow. This test is used to show if your bone marrow is making the right number of new red blood cells. It can also help doctors find out the cause of anemia.

Anemia is a low number of healthy red blood cells in the bloodstream. The body's normal response to anemia is for the bone marrow to make more reticulocytes. A low reticulocyte count is a sign that the bone marrow isn't working well.

Blood smear

For a blood smear, a drop of blood is placed on a slide so it can be viewed with a microscope. A pathologist will assess the size, shape, type, and maturity of the blood cells. This test can help count the different types of blood cells in a sample. It is also used to look for defects in blood cells such as an abnormal shape or size (dysplasia). A key feature of MDS is that it causes blood cells to look abnormal.

This test may also be used to check for blast cells in the bloodstream. Normally, blast cells are only found in the bone marrow. But, in some cases of MDS, a small number of blast cells may be found in the bloodstream.

Other tests are done to assess the cause of low blood cell counts. A number of health conditions can also cause a low number of red blood cells and other problems similar to MDS. To confirm MDS, more blood tests will be done to rule out other health conditions. The main tests that may be used to learn more about the cause of low blood cell counts are described next.

Serum EPO

EPO is a substance that tells (stimulates) the bone marrow to make more red blood cells. The body normally makes more EPO in response to low levels of oxygen, which is carried in red blood cells. Measuring the amount of EPO in the blood can help find out the cause of anemia. The amount of EPO in the blood is called serum EPO. The serum EPO level is measured in mU/mL (milliunits per milliliter).

A low level of EPO can cause anemia and may be a sign of a health problem other than MDS. A low level of EPO can also make anemia worse in a person with MDS.

Iron, ferritin, folate, and vitamin B12

Iron is a mineral that the body needs to make red blood cells. Iron is an important part of hemoglobin—the protein in red blood cells that carries oxygen. Ferritin is a protein that binds to iron and stores it for use in the body. The amount of ferritin in the blood reflects the amount of iron stored in the body.

Folate and vitamin B12 are other nutrients in the body that are needed to make red blood cells. A shortage of any one of these substances can cause anemia. A shortage of folate or vitamin B12 can also cause red blood cells to have an abnormal shape, size, or look.

Assess for thyroid problems

The thyroid makes hormones that help control how fast the body uses energy. The hormones also affect other body functions. An underactive thyroid—when it isn't making enough hormones—can lead to anemia. Thus, a test of the amount of TSH (thyroid-stimulating hormone) in the blood may be used to check how well the thyroid is working. A high level of TSH in the blood can be a sign that the thyroid isn't making enough hormones.

Copper level

Copper is a mineral that helps with many processes in the body. A low level of copper can cause the number of red blood cells and white blood cells to be low. It can also cause blood cells to have an abnormal size, shape, or look. Assessing the level of copper in the blood is not a standard test for MDS. But, it may be done in certain cases to rule out other causes of the abnormal appearance or number of blood cells.

HIV testing

HIV can cause low blood cell counts. It can also cause blood cells to have an abnormal size, shape, or look. In certain cases, tests may be done to rule out HIV as the cause of these symptoms.

HLA typing

HLAs are special proteins found on the surface of most cells in the body. The unique set of HLA proteins on a person's cells is called the HLA type or tissue type. All cells in a single person have the same HLA type. This helps the body to tell its own cells apart from foreign cells. It also affects how the body responds to foreign substances.

HLA typing is a blood test that finds a person's HLA type. This test is not needed for all patients with MDS. It is only used in certain cases, such as to find the right donor for treatment with a platelet transfusion or hematopoietic cell transplant. This is because your tissue type and the donor's tissue type must be a near-perfect match for this treatment to work.

Flow cytometry

Flow cytometry looks at the proteins on the surface of cells in a sample of blood or bone marrow. In some cases of MDS, this test may be used to identify the specific type of cells present.

Bone marrow biopsy and aspiration

To confirm MDS, a sample of bone marrow must be removed from your body for testing. A bone marrow biopsy removes a small piece of solid bone along with a small amount of soft bone marrow inside the bone. A bone marrow aspiration removes a small amount of liquid bone marrow from inside the bone. Both tests are usually done at the same time on the back of the hip bone. You will likely lie on your side or your stomach during this test. **See Figure 3.**

You may be offered a light sedative before the test. Your doctor will then clean the area of skin where the biopsy will be done. Next, you will receive local anesthesia to numb the area of skin and bone beneath. Once numb, a hollow needle will be inserted into your skin and then pushed into the bone to remove the liquid bone marrow with a syringe. Then, a wider needle will be inserted into the bone and twisted to remove the solid bone and marrow sample. You may feel some pain while the samples are being removed. Your skin may be bruised for a few days. The samples will be sent to a lab for testing.

Figure 3
Bone marrow biopsy

Doctors use a bone marrow biopsy and aspiration to remove a sample of bone marrow for testing. These tests are often done at the same time on the hip bone.

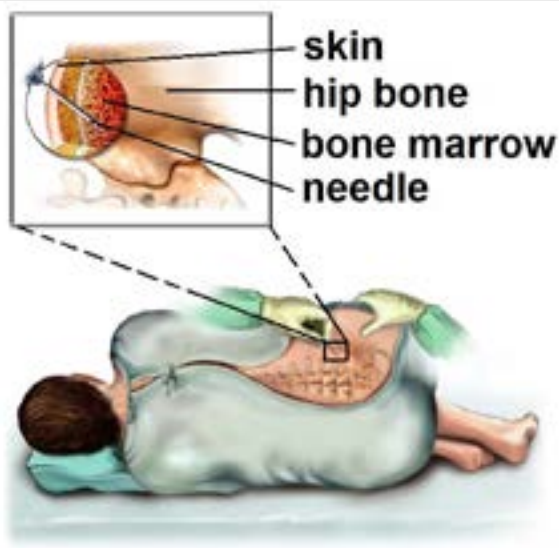


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Bone marrow tests

At the lab, a pathologist will view the bone marrow samples with a microscope. A pathologist is a doctor who's an expert in testing cells and tissue for signs of disease. He or she will assess the size, shape, type, structure, and maturity of the cells in the sample. Doctors may refer to this as a morphologic assessment.

During this assessment, the pathologist will note any signs of MDS, such as:

- Cells that have an abnormal size or shape (dysplasia).
- An abnormal number—too many or too few—of any types of blood cells.
- An increased number of young cells or very young cells (blast cells).
- More than the normal number of cells in the bone marrow—called hypercellular bone marrow.
- Less than the normal number of cells in the bone marrow—called hypocellular bone marrow.
- Red blood cells that have too much or too little iron.

A key feature of MDS is that it causes dysplasia in one or more types of blood cells. In some types of MDS, red blood cells have too much iron. To check for this, a special dye called an iron stain is placed on the sample of liquid bone marrow. The excess iron shows up as small dots in a circle (ring) around the center of the cells. Thus, these cells are called ring sideroblasts.

The number of blast cells in the bone marrow is important. In a healthy person, less than 5 percent of cells in the bone marrow are blast cells. This means that less than 5 out of every 100 bone marrow cells are blast cells. In a person with MDS, up to 19 percent of cells in the bone marrow may be blast cells. In some cases, MDS can progress to a more aggressive (fast-growing) cancer called AML. In AML, more than 20 percent of cells in the bone marrow are blast cells.

The cell assessment and iron stain are not the only tests that will be done on the bone marrow samples. Your doctor wants to rule out other disease or syndromes in the bone marrow cells so the testing gets more specific. Tests of genes and chromosomes will also be done. These are called genetic tests and they are described in the next section.

Genetic tests

Cytogenetic testing

Cytogenetic testing uses a microscope to examine the chromosomes inside of cells. This type of test is used to look for missing pieces or misplaced pieces (defects) in the chromosomes. It is often done on a sample of bone marrow. It can sometimes also be done on a sample of blood from your arm.

For this test, cells are grown in a dish, and then frozen at the time that they are about to divide. A pathologist will then look at the chromosomes and line them up to make a “map” of the chromosomes under a microscope. This map is called a karyotype. The karyotype from your bone marrow will be compared with the karyotype from a normal man or woman to see if there are any changes in the size, shape, structure, or number of chromosomes in your bone marrow. About 50 percent of patients with MDS will have a normal karyotype, the rest will have one or more changes.

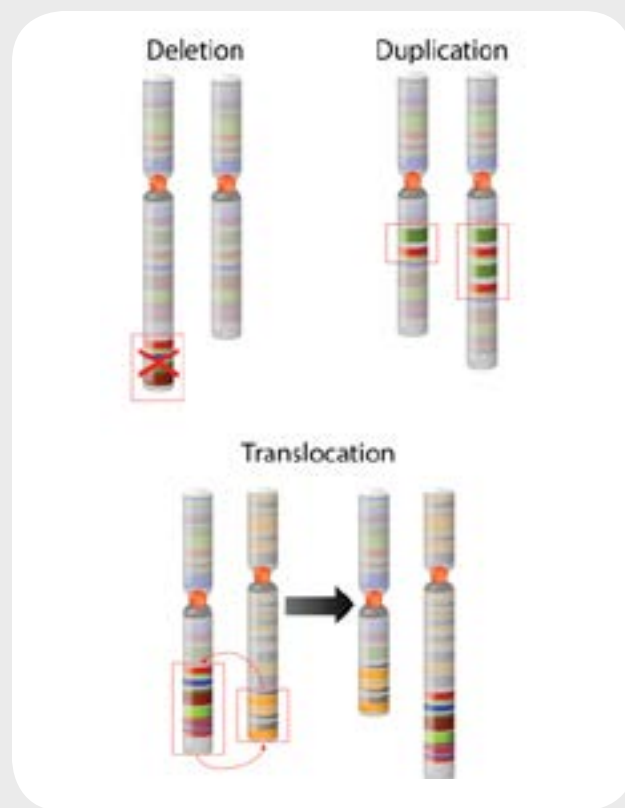
There are many types of chromosome defects. Part of a chromosome, or a whole chromosome, may be missing. Or, there may be an extra copy of a chromosome. Doctors use symbols and shortened terms to describe the different types of chromosome changes. A missing chromosome or missing part of a chromosome is noted by a minus sign (-) or the word “del” for deletion. An extra copy of a chromosome is noted by a plus sign (+). For example:

- -7 and del(7) both mean that a copy of chromosome 7 is missing.
- del(7q) and 7q- both mean that the “q” part (long arm) of chromosome 7 is missing. The “p” part is the short arm of the chromosome.
- +7 means that there is an extra copy of chromosome 7.

It is common for MDS cells to have abnormal chromosomes. About half of patients with MDS have one or more chromosome defects. In MDS cells, defects are commonly found in chromosomes 5, 7, 8, and 20. The type and number of chromosome changes helps doctors assess the likely outcome (prognosis) for your MDS. This information can also help guide treatment options.

FISH

Sometimes the bone marrow cells don't grow well. If this happens, FISH, which uses special dyes to find specific changes in a cell's genes and chromosomes can be used. FISH testing can be done on a sample of blood or bone marrow. This test detects specific gene or chromosome changes that are common and known to affect outcome in patients with MDS. FISH testing can be used in addition to karyotyping to identify specific changes that are known to be common in MDS.



Knowing if the MDS cells have certain gene changes can help to guide treatment choices. FISH is not used to confirm MDS and may not be needed for all patients.

Molecular testing

Molecular testing is more sensitive than either karyotype or FISH. With molecular testing you can find small changes (mutations) in genes that are known to have an effect on cancer treatment or outcomes. Many times, patients with a normal karyotype (50% of those with MDS) will have detectable changes at a molecular level. Molecular testing can be done on a sample of blood or bone marrow removed from your body. Molecular testing may be done in some patients with MDS to look for the following gene changes.

Recurrent gene mutations

There are certain gene mutations that are quite common in MDS. These are called recurrent gene mutations. DNA sequencing is a type of molecular test that checks for specific gene mutations in cells. Doctors use this test to find out which recurrent gene mutations are present in MDS cells. Certain mutations are linked with a better or worse prognosis. Thus, doctors may test for these common mutations to help plan treatment.

PDGFR β gene mutation

Doctors may use molecular tests to look for certain changes to the PDGFR β (platelet-derived growth factor receptor beta) gene. Changes to this gene sometimes happen in a subtype of MDS called CMML. (See page 11 for details about subtypes.) Certain treatments may work better against CMML that has this gene mutation. Thus, knowing if cells have a PDGFR β gene mutation can help guide treatment options for some patients.

Review

- A medical history, physical exam, and blood tests can reveal signs of cancer.
- Different types of blood tests are done to assess the extent and cause of low blood cell counts. Blood tests are also used to see if you have an illness other than cancer.
- A bone marrow biopsy removes a piece of bone and marrow to test for cancer cells. A bone marrow aspiration removes liquid marrow. These tests are needed to confirm MDS. Tests of bone marrow are also used to assess the prognosis of MDS.
- Genetic tests check for abnormal changes in the genes and chromosomes of MDS cells. They can be used to assess prognosis and guide treatment choices.



Being diagnosed with a rare disease like Myelodysplastic Syndromes is scary, especially if you've never even heard of the disease. Sharing your experience with others who've been in a similar situation can be empowering.

- Ray

3

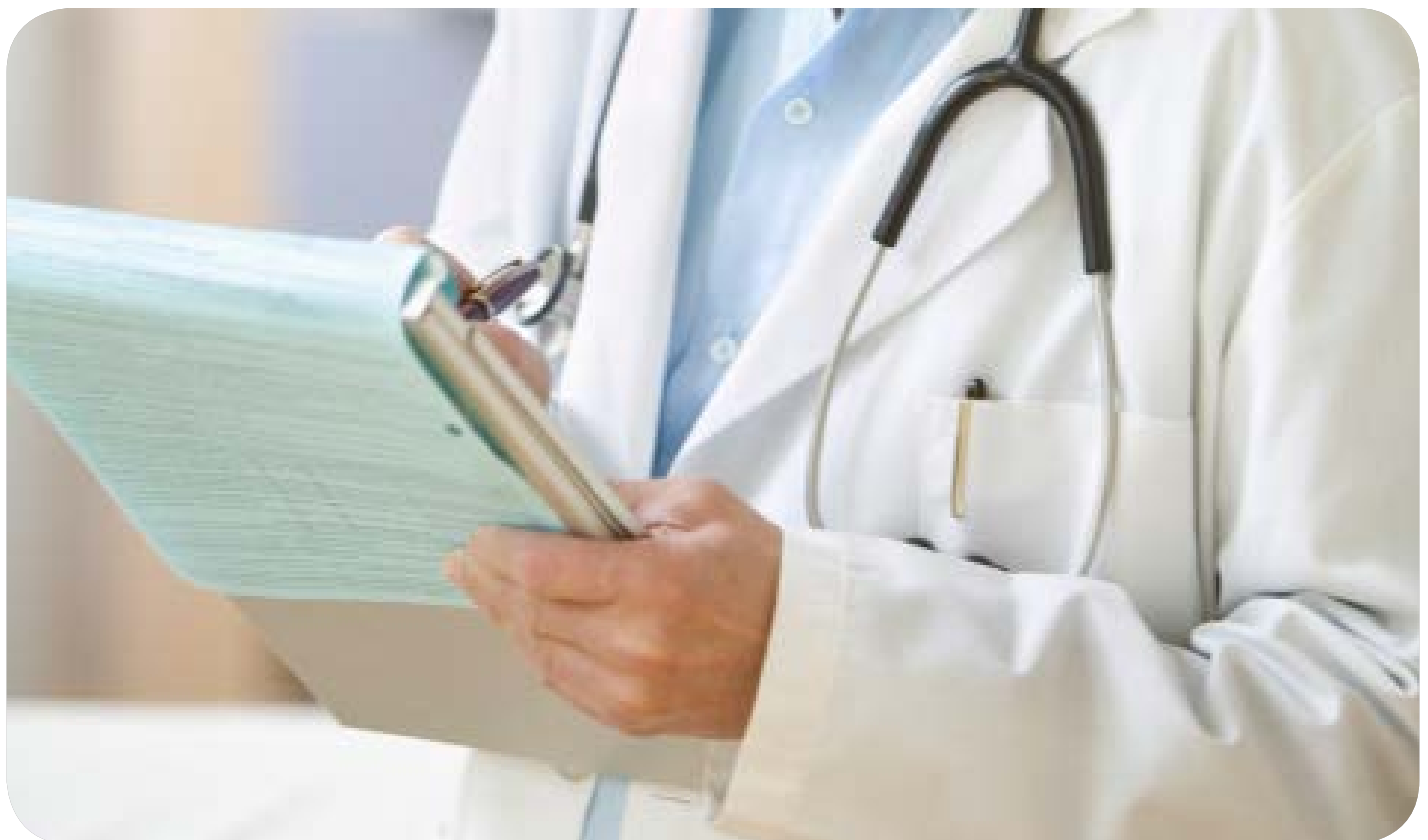
Prognostic scoring and risk groups

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Prognostic scoring is how doctors rate the severity of MDS. It is used to assess the likely outcome (prognosis) of MDS and plan treatment. The rating, called a risk score, is used to classify MDS into risk groups. Part 3 describes the key factors and scoring systems that are used for MDS.

Prognostic factors

Prognosis is a prediction of the pattern and outcome of a disease. As part of treatment planning, your doctors will assess the prognosis of your MDS. A key aspect of the prognosis of MDS is the chance (risk) that it will progress to AML. There are certain factors related to your blood counts, bone marrow assessment, and karyotype/molecular profile that affect the prognosis of MDS. These are called prognostic factors. Doctors use these factors to help decide if cancer treatment is needed right away and how intensive treatment needs to be. Such factors include:

- The MDS subtype
- The number and severity of low blood cell counts (cytopenias)
- The percent of blast cells in the bone marrow
- The type and number of chromosome changes

Some factors are linked with better outcomes or a lower chance that MDS will turn into AML. Other factors are linked with poorer outcomes or a higher chance that MDS will turn into AML. Some factors help to predict the response to treatment. Based on these prognostic factors, doctors use a scoring system to rate and classify the severity of MDS.

Prognostic scoring and risk groups

Doctors use a points system to rate the severity of MDS in each patient based on certain prognostic factors. This is called prognostic scoring. Prognostic scoring systems help predict outlook (such as survival) and the risk of progression to AML. They assign a risk score and risk group for MDS based on the prognostic factors.

First, each factor is given a score based on its severity. A lower score means a better outlook. The scores for all of the factors are then added together to make the overall risk score. The risk score describes how slow or fast MDS will likely grow and progress to AML if not treated.

The risk score is used to assign the risk group. A risk group includes cases of MDS that have the same or similar risk scores. Cases of MDS in the same risk group will behave in a similar way. Doctors use the risk group to decide what type of treatment to use and when. There are three main prognostic scoring systems for MDS:

- IPSS (**I**nternational **P**rognostic **S**coring **S**ystem)
- IPSS-R (**R**evised **I**nternational **P**rognostic **S**coring **S**ystem)
- WPSS (**W**HO classification-based **P**rognostic **S**coring **S**ystem)

IPSS

The IPSS was the first prognostic scoring system for MDS to be broadly used. It was created almost 20 years ago. Although it is still the most commonly used scoring system, many MDS specialists are moving away from the IPSS and towards the R-IPSS. As a result of these changes, the IPSS-R is better at predicting prognosis than the IPSS.

Guide 2. Prognostic scoring systems and risk groups


System	Prognostic factors that are scored	Risk groups based on total risk score	
IPSS	<ul style="list-style-type: none"> • Percent of blast cells in bone marrow <ul style="list-style-type: none"> ◦ Score of 0, 0.5, 1.5, or 2 points • Chromosome changes <ul style="list-style-type: none"> ◦ Score of 0, 0.5, or 1 point • Number of low blood counts <ul style="list-style-type: none"> ◦ Score of 0 or 0.5 point 	Low	IPSS Risk score = 0
		Intermediate-1	IPSS Risk score = 0.5 to 1.0
		Intermediate-2	IPSS Risk score = 1.5 to 2
		High	IPSS Risk score = 2.5 or higher
IPSS-R	<ul style="list-style-type: none"> • Percent of blasts in the bone marrow <ul style="list-style-type: none"> ◦ Score of 0, 1, 2, or 3 points • Chromosome changes <ul style="list-style-type: none"> ◦ Score of 0, 1, 2, 3, or 4 points • Hemoglobin level <ul style="list-style-type: none"> ◦ Score of 0, 1, or 1.5 points • Platelet count <ul style="list-style-type: none"> ◦ Score of 0, 0.5, or 1 point • Neutrophil count <ul style="list-style-type: none"> ◦ Score of 0 or 0.5 points 	Very low	IPSS-R Risk Score = 1.5 or lower
		Low	IPSS-R Risk Score = 2 to 3
		Intermediate	IPSS-R Risk Score = 3.5 to 4.5
		High	IPSS-R Risk Score = 5 to 6
		Very High	IPSS-R Risk Score = 6.5 or higher
WPSS	<ul style="list-style-type: none"> • MDS subtype <ul style="list-style-type: none"> ◦ Score of 0, 1, 2, or 3 points • Chromosome changes <ul style="list-style-type: none"> ◦ Score of 0, 1, or 2 points • Presence of severe anemia <ul style="list-style-type: none"> ◦ Score of 0 or 1 point 	Very Low	WPSS Risk Score = 0
		Low	WPSS Risk Score = 1
		Intermediate	WPSS Risk Score = 2
		High	WPSS Risk Score = 3 to 4
		Very High	WPSS Risk Score = 5 to 6

The IPSS scores three main factors to classify MDS into four risk groups. [See Guide 2](#). The scores for all of the factors are added together to make the overall risk score. This is called the IPSS score and it is used to assign the IPSS risk group.

IPSS-R

The IPSS-R was developed in 2012. It is an updated (revised) version of the original IPSS. A key way the IPSS-R differs is that it scores the types and severity of low blood cell counts. It also scores a wider range of chromosome changes. It classifies MDS into five risk groups instead of four.

Guide 3. Risk groups: Lower-risk versus higher-risk MDS

Lower-risk MDS		Higher-risk MDS
<ul style="list-style-type: none"> • IPSS Low and Intermediate-1 • IPSS-R Very Low, Low, Intermediate • WPSS Very Low, Low, Intermediate 		<ul style="list-style-type: none"> • IPSS Intermediate-2 and High • IPSS-R Intermediate, High, Very High • WPSS High, Very High

This system gives points for five main prognostic factors. See Guide 2. The points for each of the factors are added together to make the IPSS-R score and assign the IPSS-R risk group.

WPSS

The WPSS is also a newer scoring system. But, it is not used as often as the IPSS or IPSS-R. A key way the WPSS differs from the other two systems is that it includes the MDS subtype as a prognostic factor. As for low blood cell counts, the WPSS gives a score based on the presence or absence of severe anemia.

Like the IPSS-R, this system also has five risk groups. In this system, points are given for three main prognostic factors. See Guide 2. The points for each of the factors are added together to make the overall risk score. This is called the WPSS score and it is used to assign the WPSS risk group.

Risk groups: lower risk versus higher risk

When planning treatment, doctors often separate patients into two groups, dividing them into those with “lower-risk” and “higher-risk” MDS. Lower-risk MDS includes certain risk groups from each of the scoring systems. Likewise, higher-risk MDS includes risk groups from each of the scoring systems.

Guide 3 shows how the risk groups are split into these two main categories. In general, lower-risk MDS is more likely to grow and progress slowly over time. It may not cause many or severe symptoms for several years. Thus, less intensive treatment is often used. Higher-risk MDS is more likely to progress faster or turn into AML more quickly without treatment. It may cause more symptoms and health problems in a short amount of time. Thus, for patients who fall into the “higher risk” category, more intensive treatment is often recommended.

Doctors define risk-using information from large groups of patients. Thus, a risk group gives an average risk. Some people will do better than expected. Others will do worse. Several other important factors are not included in the scoring systems. These include your age, your general health, your ability to do daily activities, and any other health conditions that might complicate your treatment.

A key point to remember is that these scoring systems and risk groups do not predict how MDS will respond to treatment. They only help predict how MDS will likely behave over time without treatment.

Risk groups also give doctors a general idea of how long a group of patients with MDS might live without any disease directed treatment. This does not apply to patients who receive treatment for MDS. It also does not predict how long a specific patient might live. Some patients will live many more years than predicted using these scores and others will live many fewer years. If you want to learn more, talk to your doctor or nurse. They will be able to give you information that is specific to you.

Review

- A prognosis is a prediction of the pattern and outcome of disease.
- Something that affects and helps predict the likely outcome of a disease is called a prognostic factor.
- Doctors use prognostic scoring systems to rate the severity of MDS to help plan treatment.
- A risk score is a rating of the severity of MDS. It describes how slow or fast MDS will likely grow and progress to AML without treatment.
- MDS is classified into risk groups based on the risk score. Doctors use risk groups to decide what type of treatment is needed and when.
- When planning treatment, doctors look at the risk groups in terms of “lower-risk” MDS and “higher-risk” MDS.



Officially diagnosed with Myelodysplastic Syndromes (MDS) in October 2011, I had never heard of it, couldn't spell it, and certainly didn't know what it was! Wow, things have changed since then.

- Suzanne

4

Overview of cancer treatments

28	Supportive care
31	Chemotherapy
32	Immunotherapy
33	Immunomodulators
33	Targeted therapy
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36	Donor lymphocyte infusion
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Part 4 describes the main types of treatment for MDS. Knowing what a treatment is will help you understand your treatment options listed in the *Treatment guide* in Part 5. There is more than one treatment for MDS. Not every person will receive every treatment listed in this chapter.

Supportive care

Supportive care is treatment given to relieve the symptoms caused by cancer and side effects of cancer treatment. It doesn't treat the cancer itself. The goal of supportive care is to improve quality of life and relieve any discomfort you may have.

Supportive care is an important part of the overall treatment for MDS. It can address many needs. One example is treatment for physical and emotional symptoms. It can also help with treatment decisions and coordination between health care providers.

Low blood cell counts are very common in patients with MDS. Low blood counts can be a low number of red blood cells (anemia), a low number of platelets (thrombocytopenia), or a low number of white blood cells (neutropenia). Some patients may have only one of these, while others may have all three. Low blood cell counts can cause many symptoms and affect quality of life. Thus, supportive care is often aimed at improving these low blood cell counts to lessen the related symptoms. The main types of supportive care that are used for MDS are described next.

Blood transfusions

A blood transfusion is a slow injection of red blood cells into a vein. A red blood cell transfusion may be used to treat anemia that is causing symptoms. Symptoms of anemia include tiredness and shortness of breath. A red blood cell transfusion can help to relieve these symptoms for a short time.

Normal red blood cells live about 3 months, but transfused red blood cells last a much shorter time. More transfusions may be needed over time. Most patients with MDS will need one or more red blood cell transfusions at some point. There is no maximum number of red blood cell transfusions a patient may receive. Once a patient has had more than 20 red blood cell transfusions, it may be necessary to think about removing iron (which is carried in red blood cells).

Thrombocytopenia can cause symptoms such as easy bruising or bleeding. A platelet transfusion may be used to treat bleeding problems. There is no maximum number of platelet transfusions a patient may receive. Transfused platelets usually live less than a week, and some patients with low platelets may require transfusions regularly.

Iron chelation therapy

Iron is a mineral found in red blood cells. Receiving a large number of red blood cell transfusions can cause too much iron to build up in the body. This is called iron overload. Excess iron can collect in and damage organs such as the heart, liver, and pancreas.

Iron chelation therapy is used to treat iron overload. It is the use of drugs—called iron chelators—that bind to excess iron to remove it from the body. Deferoxamine and deferasirox are iron chelators that may be used for patients with MDS.

Deferoxamine is a liquid that is slowly injected under the skin over several hours. This is called a subcutaneous infusion. Deferasirox may be given as a tablet that is dissolved in water. Or, it may be given as a pill that is swallowed. With either drug, treatment is given once a day until iron levels have decreased to a safe level. Not all MDS patients, including those with iron overload, need iron chelation.

Antibiotics

A low number of white blood cells can increase the risk of infections. In some cases, infections may be frequent or severe. If this happens, treatment with antibiotics may be needed. Antibiotics are drugs used to treat infections caused by bacteria, fungi, or viruses. Your doctor may prescribe one or more antibiotics to decrease the risk that you will develop an infection.

Drugs for bleeding

Thrombocytopenia is a condition in which the number of healthy platelets is too low. This can cause easy bruising or bleeding. In some cases, bleeding problems may be severe or may not improve with platelet transfusions. If this happens, treatment with drugs to improve the function of platelets may be needed.

Aminocaproic acid and tranexamic acid are drugs that may be used to control bleeding problems in some patients. These are a class of drugs called antifibrinolytic agents. This type of drug works by stopping blood clots from breaking down too quickly.

Blood cell growth factors

Blood cell growth factors are substances that cause new blood cells to grow in the bone marrow. Growth factors are made naturally in the body. Copies of these natural factors can also be made in a lab to use as treatment for low blood cell counts. Growth factors may be used to treat anemia, thrombocytopenia, or neutropenia that is causing

symptoms. The growth factors that may be used for patients with MDS are described next.

White blood cell growth factors

White blood cell growth factors may be used as treatment for patients with frequent infections due to neutropenia. There are two main types of white blood cell growth factors. One is called G-CSF (**granulocyte colony-stimulating factor**). The other is called GM-CSF (**granulocyte-macrophage colony-stimulating factor**).

G-CSF helps the body to make a type of white blood cell called neutrophils. Filgrastim is a type G-CSF given with other drugs like red blood cell growth factors (see next section) and lenalidomide for lower-risk MDS. GM-CSF helps the body to make many types of white blood cells. These drugs are liquids that are injected under the skin.

Red blood cell growth factors

Red blood cell growth factors may be used as treatment for patients with anemia that is causing symptoms. These drugs are also called ESAs (**erythropoiesis-stimulating agents**) because they stimulate the bone marrow to make new red blood cells.

ESAs can increase red blood cell counts in some patients. Such patients may then need fewer red blood cell transfusions. This not only helps with symptoms like extreme tiredness and shortness of breath, but also helps to improve overall quality of life.

Epoetin alfa and darbepoetin alfa are ESAs that may be used for patients with MDS. Both drugs are liquids that are injected under the skin. These drugs work best in patients with lower levels of serum EPO. In some cases, G-CSF may be given along with an ESA to improve how well it works.

Caring for yourself: Advice from a survivor

MDS affects your bone marrow and blood, but it is not all of who you are. It is only a part of the whole person that is you. That is why it is so important not to lose sight of caring for and advocating for yourself. If you have been waiting for a chance to do this for yourself, now is the time.

There are many things you can do for yourself to improve your sense of wellness and of well-being:

- ✓ Learn all you can about MDS. Attend a nearby conference.
- ✓ Find a community of MDS people.
 - Join a support group at your hospital or cancer center.
 - Join an online community through AAMDS International Foundation or another trusted organization.

- ✓ Cultivate a positive spirit.
 - Seek out and build upon support from family and friends.
 - Take part in activities that are meaningful and satisfying to you.
 - Eat healthy meals. Get enough rest. Sleep.
- ✓ Try to get regular exercise as it can improve energy and well-being.
 - Take a walk around a beautiful park, a riverbank, or your local mall.
 - Take a community class.
 - Try tai chi, yoga, or chi-gung.
- Ruth Horsfall, MDS survivor, patient advocate, and member of the NCCN Panel for MDS

Platelet growth factors

TPO (**thrombopoietin**) is a substance that helps the body to make platelets. TPO is made naturally in the body. But, drugs that act like TPO can also be made in a lab. Romiplostim and eltrombopag are drugs that act like TPO.

Some studies have shown that these drugs might help treat low platelet counts in certain patients with MDS, but they are not approved by the FDA for this purpose. They may help to increase the number of platelets and decrease the risk of bleeding.

Chemotherapy

Chemotherapy is the use of drugs to destroy abnormal cells in the body. But, the drugs can also affect normal cells. Many people refer to this treatment as “chemo.”

Different types of chemotherapy drugs work in different ways to kill abnormal cells or stop new ones from being made. Thus, more than one drug may be used. When only one drug is used, it’s called a single agent. A combination regimen is the use of two or more chemotherapy drugs.

Chemotherapy is given in cycles of treatment days followed by days of rest. This allows the body to recover before the next cycle. Cycles vary in length depending on which drugs are used. The number of treatment days per cycle and the total number of cycles given also varies.

Some chemotherapy drugs are liquids that are injected into a vein or under the skin with a needle. Other chemotherapy drugs may be given as a pill that is swallowed. The main chemotherapy drugs used for MDS are described next. [Guide 4](#) on page 32 lists chemotherapy drugs and other drugs used to treat MDS.

Low-intensity chemotherapy

Low-intensity chemotherapy is treatment with drugs that are less likely to cause severe side effects. These drugs are often given in an outpatient setting—this means that you don’t have to spend the night in the hospital. There are two low-intensity chemo drugs approved to treat MDS:

- Azacitidine (Vidaza®)
- Decitabine (Dacogen®)

These drugs are a type of chemotherapy called hypomethylating agents. They work by blocking DNA that helps abnormal cells grow. This helps to “turn on” genes that promote the growth of normal, healthy cells in the bone marrow.

Azacitidine is a liquid that is injected into a vein or under the skin. A treatment cycle often consists of 7 days of treatment followed by 21 days of rest. At least 4 to 6 cycles should be given before this medication is declared to have failed. It is usually hard to tell if the drug is working before 4 to 6 cycles have been given; a bone marrow biopsy should be done at least every 4 to 6 months to assess the response to treatment. If treatment works well, cycles may repeat on a monthly basis until it stops working. Even if you have a complete response to treatment, your doctor may continue to give you cycles of medication.

Decitabine is a liquid that is slowly injected into a vein. This is called an IV (intravenous) infusion. The IV infusion takes 1 hour and must be given in a hospital or clinic. The 1-hour infusion is given once a day for 5 days in a row. This is repeated every 4 weeks. At least 4 to 6 cycles should be given before the drug is assessed for activity with a bone marrow biopsy. If treatment works well, cycles may repeat until it stops working.

High-intensity chemotherapy

High-intensity chemotherapy is treatment with high doses of strong drugs that are more likely to cause severe side effects. High-intensity chemo includes drugs and regimens that are used to treat AML. These drugs work in different ways to kill unhealthy cells in your blood and bone marrow, and work well against fast-growing cells. But, they are very toxic and kill normal cells along with cancer cells. Thus, doctors prefer these drugs be given in a clinical trial or before an HCT (**h**ematopoietic **c**ell **t**ransplant) for treatment of MDS. See page 35 to learn more about an HCT.

Guide 4. Drug treatments for MDS

Generic name	Brand name (sold as)	Type of drug
Azacitidine	Vidaza®	Chemotherapy (low-intensity)
Decitabine	Dacogen®	Chemotherapy (low-intensity)
Imatinib mesylate	Gleevec®	Targeted therapy
ATG (anti-thymocyte globulin, equine)	Atgam®	Immunosuppressive therapy
Cyclosporine	Neoral®, Sandimmune®	Immunosuppressive therapy
Lenalidomide	Revlimid®	Immunomodulator

Most of the high-intensity drugs are given as IV infusions. If you will have high-intensity chemo, ask your doctor about the combination of drugs given, how many cycles are needed, and how many days of treatment are in each cycle.

Side effects of chemotherapy

A side effect is an unhealthy or unpleasant physical or emotional condition caused by treatment. Each treatment for MDS can cause side effects. The reactions to chemotherapy differ between people. Some people have many side effects. Others have few. Some side effects can be very serious while others can be unpleasant but not serious. Most side effects appear soon after treatment starts and will go away after treatment ends. But, other side effects are long-term and may appear years later.

The side effects of chemotherapy depend on many factors. This includes the drug, the dose, and the person. In general, side effects are caused by the death of fast-growing cells, which are found in the intestines, mouth, and blood. Thus, common side effects of chemotherapy are nausea, vomiting, diarrhea, not feeling hungry, hair loss, and low blood cell counts.

Not all side effects of chemotherapy are listed here. Be sure to ask your treatment team for a complete list of common and rare side effects. If a side effect bothers you, tell your treatment team. There may be ways to help you feel better. There are also ways to prevent some side effects.

Immunotherapy

The immune system is the body's natural defense against infection and disease. Immunotherapy is treatment with drugs that use the immune system to help the body fight cancer. Different types of immunotherapy drugs affect the immune system in different ways. The two types of immunotherapy that may be used to treat MDS are described next.

Immunosuppressive therapy

IST (immunosuppressive therapy) is the use of drugs that lower (suppress) parts of the immune system. In some types of MDS, the immune system may attack the bone marrow by mistake. This can cause the bone marrow to not work well and not make enough blood cells. IST drugs help to stop the immune system from attacking the bone marrow.

ATG (equine) and cyclosporine are the main IST drugs that are used to treat MDS. This type of treatment doesn't work well for all cases of MDS. It tends to work better when MDS has certain features that are linked with an immune system attack. Such features include:

- Presence of HLA-DR15 tissue type, patients who are transplant eligible will have HLA typing done and this would be identified during routine HLA typing.
- A low number of cells in the bone marrow
- Younger age (<60 years) in patients with lower-risk MDS

ATG (equine) is given as an IV infusion over a few hours in the hospital. It is often given for 4 or 5 days in a row. Cyclosporine comes as a pill or a liquid that is swallowed. It is given once or twice a day and is continued for at least 6 months.

Common side effects of ATG (equine) include fever, chills, and rash at the time of the infusion. Other common side effects are fever, swelling, tiredness, and hives. Though much less common, severe allergic reactions sometimes happen. But, this can be managed with anti-allergic drugs such as prednisone. Possible side effects of cyclosporine are kidney damage, not feeling hungry, high blood pressure, and gum swelling.

Immunomodulators

Immunomodulators are drugs that modify different parts of the immune system. Lenalidomide is an immunomodulator that is used to treat MDS. It is approved to treat MDS with cells that are missing part of chromosome 5. This chromosome change is referred to as "del(5q)."

Lenalidomide treats cancer in more than one way. As an immunomodulator, it boosts the immune system. In this way, it may help the bone marrow to make normal blood cells and help kill abnormal cells in the bone marrow. It also helps stop cancer cells from increasing in number. Treatment with this drug may lessen the need for red blood cell transfusions in some patients. It works best against MDS with the del(5q) chromosome change.

Lenalidomide is made as a pill that is swallowed. It is given in cycles of treatment days followed by days of rest. A cycle may consist of 21 days (3 weeks) of treatment and 7 days (1 week) of rest. It may also be given every day for 28 days (4 weeks). Cycles may repeat until the cancer progresses or side effects become severe. Common side effects include low blood cell counts, diarrhea, itching, rash, and extreme tiredness. Ask your treatment team for a full list of side effects.

Targeted therapy

Targeted therapy is treatment with drugs that target a specific or unique feature of cancer cells. Because these drugs specifically target cancer cells, they may be less likely to harm normal cells throughout your body.

Certain treatments may be recommended for the subtype of MDS called CMML. If your doctor knows you have a PDGFR β gene mutation, he or she may offer treatment with a targeted therapy called Imatinib mesylate (see Guide 4). This drug is a TKI (tyrosine kinase inhibitor). It targets certain abnormal proteins that help cancer cells grow. Imatinib mesylate is a pill, given one or two times a day, with a full glass of water. Possible side effects include low blood cell counts, nausea, diarrhea, rash, fever, muscle pain, and extreme tiredness.

Stress and symptom control

Cancer and its treatments can cause bothersome symptoms. The stress of having cancer can also cause symptoms. There are ways to treat many symptoms, so tell your treatment team about any that you have.

You may lose sleep before, during, and after treatment. Getting less sleep can affect your mood, conversations, and ability to do daily tasks. If possible, allow yourself to rest, let people do things for you, and talk with your doctor about sleep medication. Behavioral sleep medicine—a type of talk therapy—may also help.

Feelings of anxiety and depression are common among people with cancer. At your cancer center, health care

providers such as doctors, nurses, cancer navigators, social workers, and other experts can help. Help can include support groups, talk therapy, or medication. Some people also feel better by exercising, talking with loved ones, or relaxing.

You may be unemployed or miss work during treatment. Or, you may have too little or no health insurance. Talk to your treatment team about work, insurance, or money problems. They will include information in the treatment plan to help you manage your finances and medical costs.

Hematopoietic cell transplant

An HCT is a treatment that destroys cells in the bone marrow then replaces them with new, healthy blood-forming cells. These blood-forming cells are called blood stem cells or hematopoietic stem cells. Thus, this treatment is also called a stem cell transplant.

The goal of an HCT is to cure cancer by replacing unhealthy blood stem cells with healthy ones that will attack cancer cells. This is done by suppressing the bone marrow and cancer with chemotherapy then transplanting healthy blood stem cells. The healthy blood stem cells will grow, form new bone marrow and blood cells, and attack remaining cancer cells.

For the treatment of MDS, blood stem cells from a donor are used for the transplant. This is called an allogeneic HCT. Before the transplant, special testing must be done to make sure the donor is a good match for you. HLA typing is used to find a person's tissue type, called an HLA type. (See page 17 for more details on HLA typing.)

An allogeneic HCT creates a new immune system for your body. Another benefit of this transplant is the GVL (**graft-versus-leukemia**) effect. The GVL effect is an attack on the cancer cells by the transplanted blood stem cells. The steps of treatment with an allogeneic HCT are described next.

Conditioning treatment

Before the transplant, you will receive high-dose-intensity chemotherapy. Reduced-intensity regimens may also be available. This chemotherapy is referred to as conditioning treatment since it prepares (conditions) your body to receive the donated blood stem cells. The chemotherapy destroys normal cells and cancer cells in your bone marrow. It also greatly weakens your immune system so that your body doesn't kill the transplanted blood stem cells.

There are two main types of conditioning treatment that can be used before the HCT. High-dose conditioning consists of high doses of strong (high-intensity) chemotherapy drugs. Reduced-intensity conditioning consists of lower doses of strong chemotherapy drugs or low-intensity drugs. Radiation therapy may also be given as part of conditioning treatment.

High-dose conditioning can cause very bad side effects and not all patients can tolerate it. Your doctor will look at a number of factors to decide if you are healthy enough for this treatment. Such factors include your age, your health status, the MDS risk group, and the number of blast cells in your bone marrow.

Side effects are often worse in patients who are older or have other serious health problems. Thus, high-dose conditioning is often only used for younger, healthier patients. Reduced-intensity conditioning is often used for patients who are older or less healthy overall.

Transplanting the stem cells

After the conditioning treatment, the blood stem cells will be put into your body with a transfusion. A transfusion is a slow injection of blood products into a large vein. This process can take several hours to complete.

The transplanted blood stem cells then travel to your bone marrow and grow. They will make new, healthy blood cells. This is called engraftment. It usually takes about 2 to 4 weeks.

Until then you will have little or no immune defense. This puts you at high risk for infection and bleeding. You will likely need to stay in a hospital in a very clean room for some time. It may take a few weeks or months for blood cells to fully recover so that your immune system goes back to normal.

Side effects of allogeneic HCT

A side effect is an unhealthy or unpleasant physical or emotional condition caused by treatment.

Common side effects of chemotherapy, which is given before the transplant, are described on page 32. You will likely feel tired and weak shortly after the transplant while waiting for the new blood stem cells to grow in the bone marrow.

Allogeneic HCTs have a high risk of GVHD (**graft-versus-host disease**). GVHD is when the donated cells see the cells in your body as foreign and attack them. The parts of the body most commonly damaged by GVHD are the skin, intestines, and liver.

GVHD is a serious side effect that can cause the transplant to fail by stopping the donated blood stem cells from growing in your bone marrow. GVHD can happen within a few weeks after the transplant or much later. Your doctor may give you medicine that suppresses your immune system to try to prevent this side effect.

Donor lymphocyte infusion

DLI (**donor lymphocyte infusion**) is a treatment in which the patient receives lymphocytes from the same person who donated blood stem cells for the HCT. A lymphocyte is a type of white blood cell that helps the body fight infections. The purpose of a DLI is to stimulate an immune response called the GVL effect. This treatment may be used for MDS that came back or progressed after an HCT.

Possible side effects of a DLI are similar to those caused by an allogeneic HCT. Because this treatment starts an immune response in your body, you are at risk for GVHD. Some other side effects of a DLI are weakened (suppressed) bone marrow and an increased risk of infection.



Complementary and alternative medicine

CAM (complementary and **alternative medicine**) is a group of treatments sometimes used by people with cancer. Many CAMs are being studied to see if they are truly helpful.

- Complementary medicines are meant to be used alongside standard therapies, most often for relaxation, improving your health, or to prevent or reduce side effects.
- Alternative medicine is treatment or techniques that are used instead of standard treatments such as chemotherapy or radiation. Some are sold as cures even though they haven't been proven to work in clinical trials.

Many cancer centers or local hospitals have complementary therapy programs that offer acupuncture, yoga, and other types of therapy.

It's important to tell your treatment team if you are using any complementary medicines, especially supplements, vitamins, or herbs. Some of these can interfere with your cancer treatment. For example, some supplements or herbs can increase or decrease levels of chemotherapy or targeted therapy drugs in your body. This may cause more side effects or make the treatment not work as well. For more information about CAM, ask your doctor and visit the websites in Part 6.

Clinical trials

New tests and treatments aren't offered to the public as soon as they're made. They need to be studied first. New uses of tests and treatments also need to be studied. A clinical trial is a type of research that studies a test or treatment.

Clinical trials study how safe and helpful tests and treatments are. When found to be safe and helpful, they may become tomorrow's standard of care. Because of clinical trials, the tests and treatments in this book are now widely used to help people with MDS.

Tests and treatments go through a series of clinical trials to make sure they're safe and work. Without clinical trials, there's no way to know if a test or treatment is safe or helpful. Clinical trials are done in a series of steps, called phases. The four phases of clinical trials are described next using the example of a new drug treatment:

- ▶ **Phase I** trials aim to find the best dose and way to give a new drug with the fewest side effects. If a drug is found to be safe, it will be studied in a phase II trial.
- ▶ **Phase II** trials assess if a drug works for a specific type of cancer. They are done in larger groups of patients with the same type of cancer.
- ▶ **Phase III** trials compare a new drug to the standard treatment or to a placebo—a substance with no effects. These are randomized, meaning patients are put in a treatment group by chance. Phase III trials are done to learn about short- and long-term side effects and about safety.

- ▶ **Phase IV** trials test new drugs approved by the FDA (U.S. Food and Drug Administration) to learn more about short-term side effects, long-term side effects, and safety. They involve many patients with different types of cancer.

Joining a clinical trial has benefits. First, you'll have access to the most current cancer care. Second, you will receive the best management of care. Third, the results of your treatment—both good and bad—will be carefully tracked. Fourth, you may help other patients with cancer.

Clinical trials have risks, too. Like any test or treatment, there may be side effects. Also, new tests or treatments may not help. Another downside may be that paperwork or more trips to the hospital may be needed.

To join a clinical trial, you must meet the conditions of the study. Patients in a clinical trial often have a similar cancer type and general health. This is to know that any improvement is because of the treatment and not because of differences between patients. You also must review and sign a paper called an informed consent form to join a clinical trial. This form describes the study in detail, including the risks and benefits.

Ask your treatment team if there is an open clinical trial that you can join. There may be clinical trials where you're getting treatment or at other treatment centers nearby.

Review

- Supportive care is treatment for the symptoms or health conditions caused by cancer or cancer treatment. Supportive care is an important part of treatment for MDS.
- Immunotherapy is treatment with drugs that modify the immune system to help the body fight cancer.
- Chemotherapy is the use of drugs to kill abnormal cells in the body.
- An HCT replaces damaged or diseased cells in the bone marrow with healthy blood stem cells.
- Clinical trials give people access to new tests and treatments that aren't usually received.



My advice to those with MDS is never give up. When you stop fighting, that's when you allow this disease to win.

- Shaunna

5

Treatment guide

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Part 5 is a guide through the treatment options for people with MDS. This information is taken from the treatment guidelines written by NCCN experts of MDS. These treatment guidelines list options for people with MDS in general. Thus, your doctors may suggest other treatment for you based on your health and personal wishes. Fully discuss your treatment options with your doctor.

Treatment options

There are multiple treatment options for MDS. Treatment options that are best for you depend on a number of factors. This includes the features of the cancer, such as the MDS subtype and risk score, as well as your age and health status.

The treatment options in Part 5 are organized by MDS risk groups and symptoms. The timing, intensity, and goal of treatment differs depending on the risk group. To plan treatment, doctors put risk groups into two categories: lower-risk MDS and higher-risk MDS.

- **Lower-risk MDS** includes the following risk groups: IPSS Low and Intermediate-1; IPSS-R Very Low, Low, and Intermediate; and WPSS Very Low, Low, and Intermediate.
- **Higher-risk MDS** includes the following risk groups: IPSS Intermediate-2 and High; IPSS-R Intermediate, High, and Very High; and WPSS High and Very High.

Lower-risk MDS is more likely to grow slowly and may not progress to AML for a long time. Thus, low-intensity treatments are used first. The goal of treatment for lower-risk MDS is to improve blood cell counts, lessen the need for blood transfusions, and improve quality of life.

Higher-risk MDS is more likely to grow faster and progress to AML in a shorter amount of time. Thus, high-intensity treatments are often tried first. The goal of treatment for higher-risk MDS is to slow or stop MDS progression to AML and help patients live longer.

Lower-risk MDS with anemia

Guide 5. Initial treatment for lower-risk MDS with anemia

Test results		Treatment options
del(5q) ± one other chromosome change	→	<ul style="list-style-type: none"> • Lenalidomide
No del(5q) ± other chromosome changes, and Serum EPO ≤500 mU/mL	→	<ul style="list-style-type: none"> • Epoetin alfa ± G-CSF, or • Darbepoetin alfa ± G-CSF
No del(5q) ± other chromosome changes, and Serum EPO >500 mU/mL	→	<p>If likely to respond to IST:</p> <ul style="list-style-type: none"> • ATG (equine) + cyclosporine <p>If not likely to respond to IST:</p> <ul style="list-style-type: none"> • Azacitidine • Decitabine • Consider lenalidomide • Clinical trial

Guide 5 shows the treatment options for patients with lower-risk MDS and anemia that is causing symptoms. The options differ based on the types of chromosome changes in the MDS cells and the level of EPO in your blood. One key chromosome change is when MDS cells are missing part of chromosome 5. This change is called del(5q). The amount of natural EPO in your blood is called the serum EPO level.

Treatment options for MDS with del(5q)

If MDS cells have the del(5q) chromosome change occurring alone or with one other chromosome abnormality (except any abnormality related to chromosome 7), treatment with lenalidomide may be recommended. This drug should not be given if you have an abnormal chromosome 7, a complex karyotype (3 or more abnormalities), or a very low number of neutrophils or platelets. Your doctor will also give tests during treatment to check your blood

cell counts and watch for side effects. These tests are also used to check how well treatment is working. An outcome or improvement caused by treatment is called a treatment response.

Patients who start lenalidomide often require more transfusion support during the first 3 to 4 months of treatment, but then improve. Lenalidomide can increase the risk of blood clots, so talk to your doctor about the use of aspirin or anticoagulation medicine to decrease this risk.

The goal is to increase red blood cell counts and lessen the need for red blood cell transfusions. Doctors often assess the response about 2 to 4 months after the start of treatment with lenalidomide. If tests do not show a treatment response, then your next options are the same as those listed for MDS without del(5q).

If tests show a response, you should continue this treatment until it stops working or side effects get too severe. Over time, your doctor may lower the dose of lenalidomide to lessen the side effects. (See page 33 for more details about lenalidomide.)

Treatment options for MDS without del(5q)

If tests show serum EPO ≤ 500 mU/mL, treatment with blood cell growth factors is recommended. The two main options are epoetin alfa and darbepoetin alfa. These drugs are red blood cell growth factors—also called ESAs. ESAs act like EPO and stimulate the body to make more red blood cells. Thus, they work best when there is a lower level of natural EPO in the blood.

ESAs may be given alone or along with G-CSF. G-CSF is a white blood cell growth factor. Studies show that adding G-CSF can improve how well ESAs work for some patients. See *Next steps* at the end of this section.

If tests show serum EPO > 500 mU/mL, there are four main treatment options to choose from. The options are divided into two groups. The first group includes IST drugs and the second one does not.

To decide between options, your doctor will check for factors linked with a higher chance that MDS will respond to IST. Such factors include: hypocellular bone marrow, ≤ 5 percent blast cells in bone marrow, and MDS cells with the HLA-DR15 protein. IST also tends to work better in patients who are 60 years of age or younger.

If MDS is likely to respond to IST, then you will receive ATG (equine) with cyclosporine. If MDS is not likely to respond to IST, then you have a few other options to choose from. The first option is to receive azacitidine or decitabine. Both are low-intensity chemotherapy drugs. They are also a lot alike in how they work against MDS. They can help to increase blood cell counts and lessen the need for transfusions. They can also help to slow MDS growth and progression to AML. With either drug, at least 4 to 6 cycles of treatment should be given to decide if it is working.

The second option is to receive lenalidomide. This drug works best against MDS with the del(5q) chromosome change (described above). But, it may also be helpful for some other patients, particularly those with a normal karyotype. The third option is to receive treatment within a clinical trial. (See Part 4 for more details about each treatment.)

Your doctor will give tests during treatment to check if it is working well to improve blood cell counts and other signs of MDS. How long it takes to see a treatment response depends on which treatment you have. If tests show a response, treatment may be continued until it stops working. But, treatment may need to be stopped early if side effects become too severe. This is called treatment intolerance.

Next steps

If tests do not show a treatment response, see Guide 6 on page 44 for the next treatment options. Guide 6 also includes the next options for if initial treatment stops working or side effects become too severe. For patients with serum EPO < 500 mU/mL, see Guide 10 on page 49 and Guide 11 on page 50 for more details about anemia treatment with blood cell growth factors.

Guide 6. Next treatment options for lower-risk MDS with anemia

Prior treatment		Next treatment options
<ul style="list-style-type: none"> Epoetin alfa ± G-CSF Darbepoetin alfa ± G-CSF 	→	<ul style="list-style-type: none"> Lenalidomide + epoetin alfa ± G-CSF Lenalidomide + darbepoetin alfa ± G-CSF
<ul style="list-style-type: none"> ATG (equine) + cyclosporine 	→	<ul style="list-style-type: none"> Azacitidine Decitabine Consider lenalidomide Clinical trial
<ul style="list-style-type: none"> Azacitidine Decitabine Consider lenalidomide Clinical trial 	→	<ul style="list-style-type: none"> Clinical trial Consider allogeneic HCT for certain patients

Guide 6 shows the next options for if prior treatment didn't work, stopped working, or had very bad side effects. There are several options to choose from. Which option is best for you depends on the treatment you had before.

Your doctor will give tests during treatment to check how well it's working. If tests show a treatment response, you will stay on that treatment as long as it is working well. It will be stopped once it is no longer working well. Or, it may be stopped early if side effects get very bad. If one treatment doesn't work or has to be stopped, a different option will be tried. Each time this happens, refer to the chart for the next options. These options are also described next.

After treatment with epoetin alfa or darbepoetin alfa, your doctor may consider giving lenalidomide with epoetin alfa or darbepoetin alfa. This treatment is considered if there is no response, after 3 months or loss of response, to epoetin alfa or darbepoetin alfa. ESAs may be given alone or along with G-CSF. G-CSF is a white blood cell growth factor. Studies show that adding G-CSF can improve how well ESAs work for some patients.

After treatment with ATG (equine) or cyclosporine, there are three main options to choose from next. The first option is to receive low-intensity chemotherapy with azacitidine or decitabine. The second option is to receive lenalidomide, unless you have a very low number of platelets or neutrophils. The third option is to join a clinical trial.

After treatment with azacitidine, decitabine, lenalidomide, or a clinical trial, there are two main options to choose from next. The first option is to receive treatment within a clinical trial. An allogeneic HCT may also be an option for some patients. But, it is only recommended for patients with intermediate-risk MDS and very low blood cell counts.

Next steps

If tests show progression to higher-risk MDS, see Guide 8 on page 46 for treatment options. Guide 8 also includes options for treatment with an allogeneic HCT. For detailed treatment of anemia, see Guide 11 on page 50.

Lower-risk MDS without anemia

Guide 7. Treatment for lower-risk MDS without anemia

Treatment options		Disease progression/ no response		Next options
<ul style="list-style-type: none"> • Azacitidine or decitabine • IST for certain patients • Clinical trial 	→	<ul style="list-style-type: none"> • Consider azacitidine or decitabine (if not taking already) 	→	<ul style="list-style-type: none"> • Clinical trial • Consider allogeneic HCT for certain patients

Guide 7 shows the treatment options for patients with lower-risk MDS but without anemia. Instead, the number of platelets or white blood cells is low. Or, the number of blast cells in the bone marrow is high.

Treatment options

There are three main treatment options to choose from. The first option is to receive azacitidine or decitabine. Both are low-intensity chemotherapy drugs. They are also a lot alike in how they work against MDS. They can help to increase blood cell counts and lessen the need for transfusions. They can also help to slow MDS growth and progression to AML. With either drug, at least 4 to 6 cycles of treatment should be given to decide if it is working.

Treatment with IST may also be an option for some patients. Your doctor will look at the features of the MDS cells and other factors to decide if this treatment might work well for you. If there is a good chance that MDS will respond to IST, then you will receive ATG (equine) with or without cyclosporine. The third option is to receive treatment within a clinical trial.

Treatment results and next options

Your doctor will give tests during treatment to check if it is working well to improve blood cell

counts and other signs of MDS. This is called a treatment response. How long it takes to see a treatment response depends on which treatment you have. Sometimes MDS grows or gets worse during treatment. This is called progression. The next treatment options depend on how well initial treatment worked.

If tests show a response, then you will stay on the same treatment as long as it keeps working. Once the MDS grows or gets worse, the next treatment options will be tried. If tests don't show a response, or show progression, there are other options to choose from next. You may start azacitidine or decitabine, if you are not taking it already. Your doctor may consider eltrombopag or romiplostim, if thrombocytopenia is severe or the treatment is not working to control it.

Another option is to receive treatment within a clinical trial. An allogeneic HCT may also be an option for some patients. But, it is only recommended for patients with intermediate-risk MDS and very low blood cell counts.

Next steps

If tests show progression to higher-risk MDS, see Guide 8 on page 46 for treatment options, which includes treatment with an allogeneic HCT.

Higher-risk MDS

Guide 8. Initial treatment for higher-risk MDS

Assessment before treatment		Treatment options
Allogeneic HCT is a good option for you, and a well-matched donor is available	→	<ul style="list-style-type: none"> • Allogeneic HCT • Azacitidine or decitabine followed by allogeneic HCT • High-intensity chemo followed by allogeneic HCT
Allogeneic HCT may be a good option for you, but a well-matched donor is not available	→	<ul style="list-style-type: none"> • Azacitidine (preferred) • Decitabine • Clinical trial
Allogeneic HCT is not a good option for you, or a well-matched donor is not available	→	<ul style="list-style-type: none"> • Azacitidine (preferred) • Decitabine • Clinical trial

Guide 8 shows the treatment options for higher-risk MDS. To help decide which option is best for you, your doctor will first assess if you are able to have high-intensity treatment. High-intensity treatment includes allogeneic HCT and high-intensity chemotherapy. Treatment with high-intensity chemotherapy in a clinical trial is preferred.

High-intensity treatments aim to slow or stop MDS progression to AML and improve survival. But, they can also cause very bad side effects. Side effects are often more severe for patients who are older or have other health problems. Not all patients can tolerate the severe side effects.

Your doctor will look at many factors to decide if high-intensity treatment is a good option for you. Such factors include your personal preference, your age, how well you can do daily activities, and other health conditions. Another key factor is if there is a well-matched donor for the allogeneic HCT.

If an allogeneic HCT is a good option for you and a donor has been found, there are three main options to choose from. The first option is to receive an allogeneic HCT right away. High-dose conditioning or reduced-intensity conditioning may be used for the HCT. (See page 35 for more details about conditioning treatment.)

The second option is to receive azacitidine or decitabine first and then an allogeneic HCT. This may be used to lower the number of blast cells in your bone marrow before the HCT. It may also be a good option if you are still waiting for a well-matched donor.

The third option is to receive high-intensity chemotherapy first and then an allogeneic HCT. High-intensity chemo as part of a clinical trial is preferred. The high-intensity chemo can help to lower the number of blast cells in your bone marrow before the HCT. But, it can cause very severe side effects and may not be a good choice for all patients.

If an allogeneic HCT is not a good option for you or a donor hasn't been found, there are three options to choose from. The first option is to receive azacitidine, a low-intensity chemotherapy drug. This is the preferred option for patients with higher-risk MDS who are not able to have high-intensity treatment. Azacitidine can lower the chance that MDS will progress to AML in some patients. It can also help some patients have improved blood cell counts and live longer than they would without treatment. Your doctor may refer to this as "improved survival."

The second option is to receive decitabine, which is also a low-intensity chemotherapy drug. It is a lot like azacitidine in how it works against MDS. Decitabine can lower the chance that MDS will progress to AML in some patients. The third option is to receive treatment within a clinical trial.

Next steps

See Guide 9 on page 48 for the next options after initial treatment for higher-risk MDS.

Guide 9. Next treatment options for higher-risk MDS

Prior treatment		Results		Treatment options		Next options
<ul style="list-style-type: none"> Allogeneic HCT Azacitidine or decitabine followed by allogeneic HCT High-intensity chemo followed by allogeneic HCT 	→	<ul style="list-style-type: none"> Relapse after HCT or no response 	→	<ul style="list-style-type: none"> Consider second HCT or DLI Azacitidine or decitabine Clinical trial 	→	<ul style="list-style-type: none"> If response, continue treatment If relapse or no response, clinical trial or supportive care
<ul style="list-style-type: none"> Azacitidine (preferred) Decitabine Clinical trial 	→	<ul style="list-style-type: none"> Response 	→	<ul style="list-style-type: none"> Continue treatment until it stops working 		
		<ul style="list-style-type: none"> Relapse or no response 	→	<ul style="list-style-type: none"> Clinical trial Supportive care 		

Guide 9 shows the next options used after initial treatment for higher-risk MDS. There are several options to choose from. Which option is best for you depends on which treatment you had before and how well it worked.

Your doctor will give tests during treatment to check how well it's working. An outcome or improvement caused by treatment is called a treatment response. How long it takes to see a treatment response depends on the type of treatment used. A relapse is the return or worsening of MDS after a response or period of improvement.

If you had an allogeneic HCT, and tests show a relapse or no response, there are three main options to choose from. The first option is to have a second allogeneic HCT or a DLI. This may be a good option if the response to the first HCT lasted for a while before tests showed a relapse.

The second option is to receive azacitidine or decitabine. Both are low-intensity chemotherapy drugs. They are a lot alike in how they work against MDS. With either drug, treatment should be continued as long as it is working well. The third option is to join a clinical trial.

If any of these treatments don't work or stop working, there are two more options to choose from. One option is to receive a different treatment within a clinical trial. Another option is to receive supportive care only.

If you had azacitidine or decitabine, the next options depend on how well the drug worked. With either drug, at least 4 to 6 cycles should be given before checking for a response. If tests show a response, then treatment should be continued as long as it keeps working.

If tests don't show a response, or show a relapse, there are two more options to choose from. The first option is to join a clinical trial. The second option is to receive supportive care only.

If you had treatment within a clinical trial, and the drug didn't work or stopped working, there are two more options to choose from. The first option is to receive a different drug or type of treatment within a clinical trial. The second option is to receive supportive care only.

Treatment for anemia

Guide 10. Initial care for anemia

First steps of care

- Rule out and treat other possible causes of anemia
- Replace iron, folate, or vitamin B12 if needed
- Red blood cell transfusions
- Supportive care

Guide 10 shows the initial steps to assess and care for anemia. MDS is not the only health condition that can cause anemia. A number of other factors can cause anemia. Thus, it is important to check for any other health problems that might be causing a low number of red blood cells. The tests doctors use to assess anemia are described in Part 2 on page 15.

Iron, folate, and vitamin B12 are nutrients in the body that are needed to make red blood cells. A shortage of any one of these substances can cause anemia. Thus, your doctor will want to know if you have the right amount of these nutrients. If any are low, treatment with vitamin supplements may help.

Red blood cell transfusions are the standard of care for patients with anemia that is causing symptoms. A red blood cell transfusion is a slow injection of red blood cells into a vein. This can help relieve anemia symptoms quickly. But, this relief may only last for a few months. More transfusions may be needed over time. You should also receive other supportive care as needed. (See page 28 for more details about supportive care.)

Next steps

See Guide 11 on page 50 for treatment options for MDS-related anemia.

Guide 11. Treatment for anemia that is causing symptoms

Test results		Treatment options		Response and next options
del(5q) ± one other chromosome change	→	• Lenalidomide	→	<ul style="list-style-type: none"> • If response, stay on lenalidomide • If no response, see Guide 5
Serum EPO ≤500 mU/mL, and <15% ring sideroblasts	→	<ul style="list-style-type: none"> • Epoetin alfa • Darbepoetin alfa 	→	<ul style="list-style-type: none"> • If response, stay on treatment and lower the dose if needed • If no response, consider adding G-CSF or lenalidomide, then see Guide 5 if needed
Serum EPO ≤500 mU/mL, and ≥15% ring sideroblasts	→	<ul style="list-style-type: none"> • Epoetin alfa + G-CSF • Darbepoetin alfa + G-CSF 	→	<ul style="list-style-type: none"> • If response, stay on treatment and lower the dose if needed • If no response, see Guide 5
Serum EPO >500 mU/mL	→	• See options in Guide 5		

Guide 11 shows the treatment options for anemia that is causing symptoms. The options differ based on the features of the MDS cells and the level of EPO in your blood. The amount of natural EPO in your blood is called the serum EPO level.

One key feature is whether or not the MDS cells are missing part of chromosome 5. This chromosome change is called del(5q). Another key feature is the amount of ring sideroblasts found in the bone marrow.

If MDS cells have the del(5q) chromosome change, treatment with lenalidomide may be recommended. But, this drug should not be given if you have an abnormal chromosome 7, or a very low number of neutrophils or platelets.

Your doctors will give tests during treatment to check your blood cell counts. These tests are also used to check how well treatment is working. An outcome or improvement caused by treatment is called a treatment response.

The goal is to increase red blood cell counts and lessen the need for red blood cell transfusions. Doctors often assess the response about 2 to 4 months after the start of treatment with lenalidomide. If tests show a response, you should continue this treatment until it stops working or side effects get too severe. Over time, your doctor may lower the dose of lenalidomide to lessen the side effects. (See page 33 for more details about lenalidomide.)

For patients with serum EPO ≤ 500 mU/mL, treatment with blood cell growth factors is recommended. The two main options are epoetin alfa and darbepoetin alfa. Both drugs are red blood cell growth factors—also called ESAs. ESAs are drugs that act like EPO, a substance that is made naturally in your body to stimulate the growth of new red blood cells. Thus, these drugs work best when there is a lower level of natural EPO in the blood.

If less than 15 percent of cells in the bone marrow are ring sideroblasts, then ESAs alone are suggested. If 15 percent or more of the bone marrow cells are ring sideroblasts, then G-CSF should be given along with an ESA. G-CSF is a white blood cell growth factor. Studies show that adding G-CSF can improve how well ESAs work for some patients.

Epoetin alfa is given in high doses weekly. Darbepoetin alfa is a long-acting drug and is given once every 2 weeks. Low doses of G-CSF are given weekly. (See page 29 for more details about blood cell growth factors.)

The goal of treatment with blood cell growth factors is to increase red blood cell counts and hemoglobin level and decrease the number of red blood cell transfusions needed. This often happens 6 to 8 weeks after the start of treatment. If the treatment works, it should be continued. If treatment with an ESA alone isn't working well, then G-CSF may be added. If these drugs do not improve your hemoglobin level within several months, they should be stopped and other treatment should be tried.

Your doctor will give tests during treatment to check how well it's working. If tests show a treatment response, treatment should be continued until it stops working. Over time, lower doses may be given based on the treatment response.

For patients with serum EPO >500 mU/mL, treatment with red blood cell growth factors is not recommended. EPO is made naturally in your body to stimulate your bone marrow to make more red blood cells. Red blood cell growth factors are drugs that act like EPO. These drugs don't work as well when there is a higher level of natural EPO in the blood. Therefore, other types of treatments should be used.

Next steps

If tests don't show a treatment response, or treatment stops working, see Guide 5 on page 42 for more treatment options. Guide 5 also includes treatment options for patients with serum EPO >500 mU/mL.

6

Making treatment decisions

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Review



Having cancer can feel very stressful. While absorbing the fact that you have cancer, you must also learn about tests and treatments. And, the time you have to decide on a treatment plan may feel short. Parts 1 through 5 described the test and treatment options recommended by NCCN experts. These options are based on science and agreement among NCCN experts. Part 6 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. But, 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, your treatment team may still ask that you sign a consent form.

On the other hand, you may want to take the lead or share in decision-making. In shared decision-making, you and your doctors share information, discuss 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 can decide on a plan that works best for you when it comes to your personal and health needs.

Questions to ask your doctors

You will likely meet with experts from different fields of medicine. It is helpful to talk with each person. Prepare questions before your visit and ask questions if the information isn't clear. You can get copies of your medical records. It may be helpful to have a family member or friend with you at these visits to listen carefully and even take notes. A patient advocate or navigator might also be able to come. They can help you ask questions and remember what was said.

The questions below are suggestions for information you read about in this book. Feel free to use these questions or come up with your own personal questions to ask your doctor and other members of your treatment team.

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?
2. Is this cancer common?
3. What is the cancer risk score and risk group? Does this risk score or group mean the cancer has progressed a lot?
4. Is this a fast- or slow-growing type of MDS?
5. What are the chances that this type of MDS will become AML?
6. What other tests results are important to know?
7. How often are these tests wrong?
8. Would you give me a copy of the pathology report and other test results?
9. Can the cancer be cured? If not, how well can treatment stop the cancer from growing?

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 use 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?
7. Which option is proven to work best?
8. Which options lack scientific proof?
9. What are the benefits of each option? Are my chances any better for one option than another?
10. What are the risks of each option? What are possible complications?
11. 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. Do I have a choice of when to begin treatment? Can I choose the days and times of treatment?
3. How do I prepare for treatment? Do I have to stop taking any of my medicines? Are there foods I will have to avoid?
4. Should I bring someone with me when I get treated?
5. Will the treatment hurt?
6. How much will the treatment cost me? What does my insurance cover?
7. Will I miss work or school? Will I be able to drive?
8. Is home care after treatment needed? If yes, what type?
9. How soon will I be able to manage my own health?
10. 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. It is important to learn if a doctor is an expert in the cancer treatment he or she is offering.

1. Are you board certified? If yes, in what area?
2. How many patients like me have you treated?
3. How many procedures like the one you're suggesting have you done?
4. Is this treatment a major part of your practice?
5. 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, so science isn't helpful. Some ways to decide on treatment are discussed next.

Getting a 2nd opinion

Even if you like and trust your doctor, it is helpful to get a 2nd opinion. You will want to have another doctor review your test results. He or she can suggest a treatment plan or check the one you already heard about.

Things you can do to prepare:

- ▶ Check with your insurance company about its rules on 2nd opinions. You want to know about out-of-pocket costs for doctors who are not part of your insurance plan.
- ▶ Make plans to have copies of all your records sent to the doctor you will see for your 2nd opinion. Do this well before your appointment. If you run into trouble having records sent, pick them up and bring them with you.

If the new doctor offers other advice, make an appointment with your first doctor to talk about the differences. Do whatever you need to feel confident about your diagnosis and treatment plan.

Getting support

Support groups often include 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 MDS. If your hospital or community doesn't have support groups for people with MDS, check out the websites on the next page.

You can also reach out to a social worker or psychologist. They can help you find ways to cope or refer you to support services. These services may also be available to your family, friends, and to those with children, so they can connect and get support.

Keep in mind...

- ✓ Every treatment option has benefits and risks. Consider these when deciding which option is best for you.
- ✓ Talking to others may help identify benefits and risks you haven't thought of.

Websites and resources

Aplastic Anemia and MDS International Foundation (AAMDSIF)
aamds.org/about/MDS

American Cancer Society
cancer.org/cancer/myelodysplasticsyndrome/index

cancer.org/Treatment/FindingandPayingforTreatment/index

The Leukemia and Lymphoma Society (LLS)
lls.org/disease-information/myelodysplastic-syndromes

MDS Foundation, Inc.
mds-foundation.org

National Cancer Institute
cancer.gov/types/myeloproliferative/patient/myelodysplastic-treatment-pdq

National Coalition for Cancer Survivorship
canceradvocacy.org/toolbox

NCCN
nccn.org/patients/resources/life_with_cancer/default.aspx

100 Questions & Answers about Myelodysplastic Syndromes
 by Jason Gotlib, MD, MS & Lenn Fetcher, RN
mds-foundation.org/100-questions-answers-about-myelodysplastic-syndromes

Support groups and events

Aplastic Anemia and MDS International Foundation (AAMDSIF)
aamds.org/support

The Leukemia and Lymphoma Society (LLS)
lls.org/support/support-groups

MDS Foundation, Inc.
mds-foundation.org/patient-caregiver-resources

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 benefits and risks may help you decide which treatment is best for you.



I would never have made it through the tough spots without my husband, my family and friends - and my faith. Surround yourself with positive thinkers, eliminate or at least limit anyone who is negative from your daily routine.

- Kate

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Dictionary

acute myeloid leukemia (AML)

A fast-growing cancer that starts in the bone marrow and causes too many immature white blood cells to be made.

allogeneic hematopoietic cell transplant (HCT)

A treatment in which the patient receives healthy, immature blood-forming cells from another person to replace damaged or diseased cells in the bone marrow.

anemia

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

BCR-ABL1 gene

An abnormal gene that is formed when parts of chromosomes 9 and 22 break off and switch with each other. This gene is found on the Philadelphia chromosome and is the key feature of chronic myeloid leukemia.

biopsy

Removal of small amounts of tissue from the body to be tested for disease.

blast cell

An immature blood cell.

blood cell count

The number of blood cells in a sample of blood.

blood cell growth factors

Substances that cause new blood cells to grow in the bone marrow.

blood smear

A test in which a drop of blood is placed on a slide and viewed with a microscope to assess the size, shape, type, and maturity of the blood cells.

blood stem cell

An immature blood-forming cell from which all other types of blood cells are made. Also called hematopoietic stem cell.

bloodstream

Blood that flows throughout the body in small tubes called blood vessels.

bone marrow

The soft, sponge-like tissue in the center of most bones where blood cells are made.

bone marrow aspiration

The removal of a small amount of liquid bone marrow to test for disease.

bone marrow biopsy

The removal of a small amount of solid bone and bone marrow to test for disease.

chemotherapy

Treatment with drugs that kill abnormal cells or stop new ones from being made.

chromosomes

Long strands that contain bundles of coded instructions in cells for making and controlling cells.

chronic myeloid leukemia (CML)

A slow-growing cancer that starts in the bone marrow and causes too many white blood cells called granulocytes to form.

clinical trial

Research on a test or treatment to assess its safety or how well it works.

complete blood count (CBC)

A test of the number of blood cells in a sample.

conditioning treatment

Treatment that is used to destroy cells in the bone marrow to prepare (condition) the body for a hematopoietic cell transplant.

cycle

Days of treatment followed by days of rest.

cytogenetic testing

A test that uses a microscope to examine a cell's chromosomes—long strands of coded instructions in cells for making and controlling cells.

cytopenia

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

del(5q)

An abnormal chromosome change in which the “q” part of chromosome 5 is missing (deleted).

deoxyribonucleic acid (DNA)

A chain of chemicals in cells that contains coded instructions for making and controlling cells.

diagnose

To confirm or identify a disease or health condition.

differential

Measurement of the different types of white blood cells present in a blood sample.

donor

A person who gives their organs, tissues, or cells to another person.

donor lymphocyte infusion (DLI)

Procedure in which the patient receives white blood cells from the same person who donated blood-forming cells (blood stem cells) for the stem cell transplant.

dysplasia

Cells have an abnormal size, shape, or look (appearance) when viewed with a microscope.

erythropoiesis-stimulating agent (ESA)

A drug that tells (stimulates) the bone marrow to make more red blood cells.

erythropoietin (EPO)

A substance that is made naturally in the body and that tells (stimulates) the bone marrow to make more red blood cells.

fatigue

Severe tiredness despite getting enough sleep that limits one's ability to function.

flow cytometry

A test that looks at certain 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 changes in a cell's genes and chromosomes.

folate

A nutrient in the body that is needed to make red blood cells.

gene

A set of coded instructions in cells for making and controlling cells.

gene mutation

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

genetic tests

Tests of the coded instructions in cells that are needed to make and control cells. These instructions are called genes and they are grouped into long strands called chromosomes.

graft-versus-host disease (GVHD)

A disease that occurs when transplanted blood stem cells (immature blood-forming cells) from a donor attack a patient's normal cells.

graft-versus-leukemia (GVL) effect

An attack on cancer cells by transplanted blood stem cells (immature blood-forming cells) from a donor.

granulocyte colony-stimulating factor (G-CSF)

A substance that helps (stimulates) the bone marrow to make more white blood cells called neutrophils. It is made naturally in the body but can also be made in a lab.

granulocyte-macrophage colony-stimulating factor (GM-CSF)

A substance that helps (stimulates) the bone marrow to make more of certain types of white blood cells. It is made naturally in the body but can also be made in a lab.

hematopoietic cell transplant (HCT)

A treatment that replaces damaged or diseased cells in the bone marrow—sponge-like tissue in the center of bones where blood cells are made—with healthy blood-forming cells. Also called stem cell transplant.

hematopoietic stem cell or hematopoietic cell

An immature blood-forming cell from which all other types of blood cells are made. Also called blood stem cell.

hemoglobin

A protein in red blood cells that carries oxygen.

high-intensity chemotherapy

Treatment with high doses of strong cancer drugs that are more likely to cause severe side effects.

high-intensity treatment

Treatment that is more likely to cause severe side effects and often requires a hospital stay.

higher-risk MDS

MDS that is more likely to progress faster or turn into acute myeloid leukemia quickly if not treated.

HLA-DR15

An immune system protein that is found on the surface of some cells. The presence of the protein on MDS cells can affect how well immunosuppressive therapy works.

hormone

A chemical in the body that activates cells or organs.

human leukocyte antigen (HLA)

Special proteins on the surface of cells that help the body to tell its own cells apart from foreign cells.

human leukocyte antigen (HLA) type

The unique set of proteins on the surface of cells that help the body to tell its own cells apart from foreign cells.

human leukocyte antigen (HLA) typing

A blood test that finds a person's HLA type—the unique set of proteins on the surface of cells that help the body to tell its own cells apart from foreign cells.

hypocellular bone marrow

The number of cells in the bone marrow is lower than normal.

immune response

The action of the body's natural defense against infections and disease in response to foreign substances.

immune system

The body's natural defense against infection and disease.

immunomodulators

Drugs that change (modify) different parts of the immune system.

immunosuppressive therapy (IST)

Treatment with drugs that weaken (suppress) the body's immune system.

immunotherapy

Treatment with drugs that modify the immune system to help the body fight cancer.

International Prognostic Scoring System (IPSS)

A system that doctors use to rate the severity of MDS and classify it into groups based on the likely outcome (prognosis).

intestine

The organ that food passes through after leaving the stomach.

intravenous (IV)

Given by a needle or tube inserted into a vein.

intravenous (IV) infusion

A method of giving drugs slowly through a needle into a vein.

iron

A mineral that is found in red blood cells and that the body needs to make new red blood cells.

iron chelation therapy

Treatment that is used to remove excess iron from the body.

iron overload

The buildup of excess iron in the body.

local anesthesia

A controlled loss of feeling in a small area of the body caused by drugs.

low-intensity chemotherapy

Treatment with cancer drugs that are less likely to cause severe side effects.

low-intensity treatment

Treatment that is less likely to cause severe side effects and usually does not require a hospital stay.

lower-risk MDS

MDS that is more likely to grow and progress slowly and may not cause many or severe symptoms for a long time.

lymphocyte

A type of white blood cell that helps protect the body from infection and disease.

medical history

All health events and medications taken to date.

microscope

A tool that uses lenses to see things the eyes can't.

molecular test

Tests that look for abnormal changes in genes known to have an effect on cancer treatment or outcomes.

monocyte

A type of white blood cell.

mutation

An abnormal change.

myeloproliferative neoplasm (MPN)

A cancer in which the bone marrow makes too many red blood cells, white blood cells, or platelets.

neutropenia

A condition in which the number of white blood cells called neutrophils is low.

neutrophil

A type of white blood cell that helps fight infections and has small particles (granules).

pathologist

A doctor who is an expert in testing cells and tissue to find disease.

Philadelphia chromosome

An abnormal chromosome that is formed when parts of chromosomes 9 and 22 break off and switch with each other. It contains the abnormal *BCR-ABL1* gene and is a key feature of chronic myeloid leukemia.

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.

platelet transfusion

A slow injection of platelets—blood cells that help control bleeding—into a vein.

prognosis

The likely or expected course, pattern, and outcome of a disease based on tests.

prognostic factor

Something that affects and helps predict the likely pattern and outcome of a disease.

prognostic scoring system

A system that doctors use to rate the severity of MDS and classify it into groups based on the likely outcome (prognosis).

progression

The course of a disease as it grows, gets worse, or spreads in the body.

protein

A chain of small chemical compounds important to every cell in the body.

red blood cell

A type of blood cell that carries oxygen from the lungs to the rest of the body.

red blood cell growth factor

A substance that causes new red blood cells to grow in the bone marrow. It is made naturally in the body but can also be made in a lab to use as treatment.

red blood cell transfusion

A slow injection of red blood cells into a vein.

reduced-intensity conditioning

Treatment with lower doses of strong cancer drugs or low-intensity drugs that is used to destroy cells in the bone marrow to prepare (condition) the body for a hematopoietic cell transplant.

regimen

A treatment plan that specifies the dose, schedule, and duration of treatment.

relapse

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

reticulocyte

Younger (precursor) cells that become mature red blood cells.

Revised International Prognostic Scoring System (IPSS-R)

A newer system that doctors use to rate the severity of MDS and classify it into groups based on the likely outcome (prognosis).

ring sideroblasts

Young red blood cells that have too much iron and shows up as a circle (ring) around the center of the cells.

risk group

Classification of MDS based on its severity and the chance (risk) that it will progress to AML (acute myeloid leukemia).

risk score

A rating of the severity of MDS that describes how fast or slow it will likely grow and progress.

sedative

A drug that helps a person to relax or go to sleep.

serum EPO

The amount of natural erythropoietin—a substance made in the body that causes red blood cells to grow—that is found in the blood.

side effect

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

subtype

Smaller groups that a type of cancer is divided into based on certain features of the cancer cells.

supportive care

Treatment for the symptoms or health conditions caused by cancer or cancer treatment.

symptom

A new or changed health problem a person experiences that may indicate a disease.

thrombocytopenia

A condition in which there is a low number of platelets— blood cells that help control bleeding.

transfusion

A slow injection of whole blood or parts of blood into a vein.

treatment response

An outcome or improvement in disease that is caused by treatment.

U.S. Food and Drug Administration (FDA)

A federal government agency that regulates drugs and food.

vitamin B12

A nutrient in the body that is needed to make red blood cells.

white blood cell

A type of blood cell that helps fight infections in the body.

white blood cell growth factor

A substance that causes new white blood cells to grow in the bone marrow. It is made naturally in the body but can also be made in a lab to use as treatment.

WHO classification-based Prognostic Scoring System (WPSS)

A system that doctors use to rate the severity of MDS and classify it into groups based on the likely outcome (prognosis).

Acronyms

AML

acute myeloid leukemia

ATG

antithymocyte globulin

CAM

complementary and alternative medicine

CBC

complete blood count

CML

chronic myeloid leukemia

CMML

chronic myelomonocytic leukemia

DLI

donor lymphocyte infusion

DNA

deoxyribonucleic acid

EPO

erythropoietin

ESA

erythropoietin-stimulating agent

FAB

French-American-British

FDA

U.S. Food and Drug Administration

FISH

fluorescence in situ hybridization

G-CSF

granulocyte colony-stimulating factor

GM-CSF

granulocyte-macrophage granulocyte colony-stimulating factor

GVHD

graft-versus-host disease

GVL

graft-versus-leukemia

HCT

hematopoietic cell transplant

HIV

human immunodeficiency virus

HLA

human leukocyte antigen

LDH

lactate dehydrogenase

IPSS

International Prognostic Scoring System

IPSS-R

Revised International Prognostic Scoring System

IST

immunosuppressive therapy

IV

intravenous

MDS

myelodysplastic syndromes

MDS/MPN

myelodysplastic/myeloproliferative neoplasms

mU/mL

milliunits per milliliter

PDGFR β

platelet-derived growth factor receptor beta

TKI

tyrosine kinase inhibitor

TPO

thrombopoietin

TSH

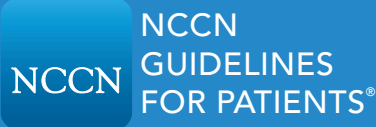
thyroid-stimulating hormone

WHO

World Health Organization

WPSS

WHO classification-based Prognostic Scoring System



New!
NCCN
Patient Guides
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MOBILE APP



TRUE INSIGHT

FOR PEOPLE LIVING WITH CANCER

NCCN Guidelines for Patients® provide treatment guidance from leading cancer experts.

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Locally Advanced (Stage III)
Metastatic (Stage IV)

Chronic Lymphocytic Leukemia

Chronic Myelogenous Leukemia

Colon Cancer

Distress (Supportive Care Series)

Esophageal Cancer

Hodgkin Lymphoma

Kidney Cancer

Lung Cancer (Non-Small Cell
Lung Cancer)

Lung Cancer Screening

Malignant Pleural Mesothelioma

Melanoma

Multiple Myeloma

Myelodysplastic Syndromes

Myeloproliferative Neoplasms

Nausea and Vomiting
(Supportive Care Series)

Non-Hodgkin's Lymphomas
Diffuse Large B-cell Lymphoma
Follicular Lymphoma
Mantle Cell Lymphoma
Mycosis Fungoides
Peripheral T-cell Lymphoma

Ovarian Cancer

Pancreatic Cancer

Prostate Cancer

Rectal Cancer

Soft Tissue Sarcoma

Stomach Cancer

Thyroid Cancer

Waldenström's Macroglobulinemia/
Lymphoplasmacytic Lymphoma

Translations:

Kidney Cancer

Chinese

German

Spanish

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GEORGIA: The following information will be sent upon request:

(A) A full and fair description of the programs and activities of NCCN Foundation; and (B) A financial statement or summary which shall be consistent with the financial statement required to be filed with the Secretary of State pursuant to Code Section 43-17-5.

KANSAS: The annual financial report for NCCN Foundation, 275 Commerce Drive, Suite 300, Fort Washington, PA 19034, 215-690-0300, State Registration # 445-497-1, is filed with the Secretary of State.

MARYLAND: A copy of the NCCN Foundation financial report is available by calling NCCN Foundation at 215-690-0300 or writing to 275 Commerce Drive, Suite 300, Fort Washington, PA 19034. For the cost of copying and postage, documents and information filed under the Maryland charitable organizations law can be obtained from the Secretary of State, Charitable Division, State House, Annapolis, MD 21401, 1-410-974-5534.

MICHIGAN: Registration Number MICS 45298. **MISSISSIPPI:** The official registration and financial information of NCCN Foundation may be obtained from the Mississippi Secretary of State's office by calling 888-

236-6167. Registration by the Secretary of State does not imply endorsement by the Secretary of State.

NEW JERSEY: INFORMATION FILED WITH THE ATTORNEY GENERAL CONCERNING THIS CHARITABLE SOLICITATION AND THE PERCENTAGE OF CONTRIBUTIONS RECEIVED BY THE CHARITY DURING THE LAST REPORTING PERIOD THAT WERE DEDICATED TO THE CHARITABLE PURPOSE MAY BE OBTAINED FROM THE ATTORNEY GENERAL OF THE STATE OF NEW JERSEY BY CALLING (973) 504-6215 AND IS AVAILABLE ON THE INTERNET AT www.njconsumeraffairs.gov/ocp.htm#charity.

REGISTRATION WITH THE ATTORNEY GENERAL DOES NOT IMPLY ENDORSEMENT. **NEW YORK:**

A copy of the latest annual report may be obtained from NCCN Foundation, 275 Commerce Drive, Suite 300, Fort Washington, PA 19034, or the Charities Bureau, Department of Law, 120 Broadway, New York, NY 10271.

NORTH CAROLINA: FINANCIAL INFORMATION ABOUT THIS ORGANIZATION AND A COPY OF ITS LICENSE ARE AVAILABLE FROM THE STATE SOLICITATION LICENSING BRANCH AT 888-830-4989 (within North Carolina) or (919) 807-2214 (outside of North Carolina). THE LICENSE IS NOT AN ENDORSEMENT BY THE STATE.

PENNSYLVANIA: The official registration and financial information of NCCN Foundation may be obtained from the Pennsylvania Department of State by calling toll-free within Pennsylvania, 800-732-0999. Registration does not imply endorsement.

VIRGINIA: A financial statement for the most recent fiscal year is available upon request from the State Division of Consumer Affairs, P.O. Box 1163, Richmond, VA 23218; 1-804-786-1343.

WASHINGTON: Our charity is registered with the Secretary of State and information relating to our financial affairs is available from the Secretary of State, toll free for Washington residents 800-332-4483.

WEST VIRGINIA: West Virginia residents may obtain a summary of the registration and financial documents from the Secretary of State, State Capitol, Charleston, WV 25305. Registration does not imply endorsement.

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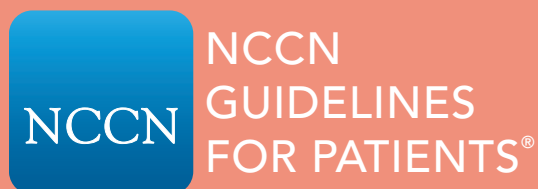
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