



**The Leukemia &  
Lymphoma Society®**  
*Fighting Blood Cancers*

# Understanding Drug Therapy and Managing Side Effects

LEUKEMIA

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Oncology

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This booklet provides information about drugs and their most frequent side effects. It is designed to provide general information in regard to the subject matter covered. It is distributed as a public service by The Leukemia & Lymphoma Society, with the understanding that the Society is not engaged in rendering medical or other professional services. Medicine is a constantly changing science. Human error and changes in practice make it impossible to certify the precise accuracy of such complex material. Confirmation of this information from other sources, especially one's physician, is required.

# Introduction

There are about 785,000 people in the United States living with leukemia, Hodgkin and non-Hodgkin lymphoma, myeloma, myelodysplastic syndromes and other blood cancers. Treatment for blood cancers generally includes one or more of the following: drug therapy, monoclonal antibody therapy, radiation therapy or stem cell transplantation. More than 50 drugs of different types are now being used to treat these diseases.

Patients with blood cancers are usually treated with a type of drug therapy referred to as “chemotherapy” - the term for certain drugs or chemicals used to kill or damage cancer cells in the body. These drugs, used singly or in combination, are sometimes called “anticancer agents.”

The progress in treatment outcomes for blood cancer patients during the last 50 years is largely due to the development of new drugs and new drug combinations. In the past decade alone, new drugs and new uses for existing drugs have greatly improved patients’ cure rates or the duration of remission. Several newer targeted therapies offer advantages to patients that include decreased side effects, higher overall response rates and better tolerance for older patients.

Information and communication are the first steps in cancer therapy. It is important for physicians and nurses to both provide patients with information about drug dosage, administration and possible drug side effects and confirm their understanding. Patients and families should inform their physicians about their medical histories, ask questions, write or record instructions about their drugs and report any side effects to their physicians.

Information about many of the major drugs used to treat blood cancers and their side effects can be found in part 3 of this booklet, **Potential Side Effects of Individual Drugs**. Unfortunately, most drugs used to treat cancer affect normal cells as well as cancer cells. Cell types that divide rapidly are the most affected, such as hair follicle cells, cells that line the gastrointestinal tract and stem cells that produce blood and immune cells. This is why hair loss, nausea, diarrhea and low blood-cell counts are common side effects of cancer treatments. Side effects may vary greatly among different patients, depending on the drug(s), dosage, length of therapy, individual reactivity, and the presence of other health problems (such as diabetes or kidney disease).

The Society’s other free materials, including *Blood and Marrow Stem Cell Transplantation*, *Blood Transfusion*, *Understanding Clinical Trials for Blood Cancers*, *Immunotherapy* and *Vaccine Therapy* are listed in **Resources** on page 67.

# Part 1: How Drug Therapies Work

The goal of drug therapy is to eliminate cancer cells so that there is no longer any sign of illness and to permit normal cells to be restored and to function (called “remission”). Current drug therapy can produce long-term remission or outright cure for many children and some adults, depending on the type and extent of the cancer. Many cases of childhood leukemia or lymphoma have high cure rates. Certain types of blood cancers that occur in adults also have good remission or cure rates. Even in the absence of a cure, remissions can last for extended periods, and retreatment after relapse can be successful. In addition, the use of stem cell transplantation may lead to a cure in patients who cannot be successfully treated by drug therapy alone.

Drug therapy can speed up cancer cell death when either too many cells are being made or too few cells are dying, or both. Normal cells are produced in a regulated way, with new cells replacing those that undergo natural death. In contrast, cancer cells may grow too fast or fail to undergo cell death at an appropriate rate, causing an accumulation or mass of cells. Chemotherapy usually accelerates cell death; the mutant cellular pathways that prevent cancer cell death are critical causes of drug resistance.

The method used to administer a drug depends on the patient’s diagnosis and the drug’s characteristics. For example, drugs that might damage tissues if given by mouth or by injection under the skin or in a muscle may be infused into a vein (intravenous administration). The four most common methods of drug administration are intravenous (IV), oral (by mouth), intramuscular (into a muscle) and intrathecal (within the spinal canal). Side effects depend in part on how a drug is given.

**Intravenous (IV) Medications.** These may be given through a vein in the forearm or through a catheter or port to access the vein. Some drugs can be given via a small plastic tube inserted in a vein, usually in the forearm. There may be some discomfort during insertion caused by the needle stick. After that, administration of the drug is usually painless. Medication flows from a solution in a plastic bag through tubing into the bloodstream.

Patients who are being treated with intravenous chemotherapy may benefit from having a long-term IV catheter inserted. Certain medications irritate the veins and make repeated IV placement difficult. Long-term catheters (referred to as “tunneled catheters,” “central lines,” “Hickman®,” “Broviac,” “Groshong®” catheters) can remain in place for very long periods. They are used in the hospital as well as at home. Many patients find that chemotherapy can be given more conveniently and comfortably through a central line than through a regular IV. The central line can also be used to give IV fluids, blood products and other medications, such as antibiotics, and to draw blood for testing.

To place the central line, a small incision is made where the catheter enters the vein and the IV line is passed under the skin to a second small incision at a distance from the first. This distance helps prevent infection. Most catheters are positioned on the chest wall. Placement is usually done with local anesthesia. There may be a few stitches at one or both sites until the areas have healed. Small, clear dressings are changed frequently to prevent infection. Hospital or clinic staff will show patients or family how to clean and care for the central line.

An implanted port is another type of long-term catheter to a central vein. The port is surgically inserted under the skin's surface on the upper chest wall. After the site heals, no dressings are needed and no special home care is required. When medicines are needed, a physician, physician assistant or nurse inserts a needle through the skin to access the port. The patient can choose to have a local numbing cream applied to the injection site before the port is used. Blood can be drawn, and blood products can be received through this device.

Short-term catheters are temporary access devices for administering therapy. These work in the same way as tunneled catheters but are removed before the patient leaves the hospital. Short-term catheters are put in place in the patient's hospital room. A local anesthetic is injected around the insertion site. The site, located near the neck or collarbone, is kept covered with a dressing.

**Oral Medications.** Some medications are taken by mouth in the form of a pill, capsule or liquid. Examples of blood cancer drugs that are taken by mouth are thalidomide, lenalidomide and imatinib mesylate. The side effects of oral chemotherapy are similar to those from IV chemotherapy.

For many people, taking medications by mouth is the most convenient method. However, patients must understand the medication dosage and frequency, food-drug and drug-drug interactions, storage and handling, and potential side effects. To protect against medication mistakes, patients should double-check with their healthcare providers about these aspects of their medication(s). It is necessary to take these drugs exactly as prescribed. Some patients find that medication calendars and planners are useful. Timers can be set as reminders to take medications.

**Intramuscular Medications.** These are injected into the muscle, usually in the arm, thigh or buttock. There is a slight pinch, lasting a few seconds, as the needle is slipped through the skin and into the muscle. Some drugs may be injected into the tissue under the skin, rather than into the muscle. This is referred to as a "subcutaneous injection."

**Intrathecal Medications** Certain types of leukemia and lymphoma have a tendency to spread to the nervous system. To prevent or treat this, a physician may perform a lumbar puncture (spinal tap) and inject an anticancer drug into the spinal fluid to destroy cancer cells. This is known as “intrathecal drug delivery.” If many treatments are needed, doctors may place a long-term device, called an “Ommaya reservoir,” under the scalp. Once the device is inserted, drugs can be given through the Ommaya reservoir, and the patient will no longer need spinal taps. The patient can go home with the Ommaya reservoir in place.

## Part 2: Drug Therapy Side Effects by Type

Drugs that damage or destroy cancer cells also affect normal cells and may cause certain side effects. Many of the side effects for each drug are identified during the research studies (clinical trials) that are done before the drug can be approved. Side effects do not always occur. Occasionally, unexpected side effects occur. However, possible side effects can often be predicted because certain drugs are more likely than others to affect specific types of body tissues, such as those that make up the nervous system, kidneys, bladder, heart and lungs.

Most side effects are temporary and subside once the body adjusts to therapy or when therapy is completed. During and following the completion of therapy, healthy new cells begin to grow and develop each day. Less commonly, a drug or drug combination used to treat blood cancer has side effects that continue for a period of time after treatment ends. Some effects may be permanent.

Physicians and patients should discuss the possible side effects of treatment so that proper planning, evaluation and follow-up can take place. Side effects are not always drug-specific and may be related to something other than the drug therapy. Effects may occur after treatment has ended. See the Society’s free fact sheet *Long-Term and Late Effects of Treatment for Blood Cancers* for more information. Certain side effects can be unpleasant, but they must be measured against the benefits of the therapy and the risks of not receiving the treatment.

The information in this section and the next section, **Potential Side Effects of Individual Drugs**, is not medical advice. It is a general description of some possible side effects and features of specific anticancer drugs. Other sources of information are the patient’s healthcare team, the drug manufacturer’s package

insert, and the *Physicians' Desk Reference* ([www.PDR.net](http://www.PDR.net)). Always consult with your healthcare provider for information related to drug treatment or side effects. Before having medical or dental exams, tests, treatments or surgery (including dental surgery) or emergency treatment, tell the medical doctor or dentist in charge about the specific medications and treatment that you are receiving or have received.

## The Gastrointestinal (GI) Tract

The lining of the mouth, esophagus, stomach and intestines contains cells with rapid turnover. If these cells are destroyed by drug therapy, sores (called “ulcers”) and other difficulties, such as vomiting or diarrhea, can develop.

**Mouth and Throat Symptoms.** If sores develop from chemotherapy, a patient may experience a burning sensation or pain in the mouth or throat. These areas may ulcerate. This is a condition called “stomatitis.” With some anticancer drugs, the amount of saliva in the mouth may decrease early on and increase later. The tongue may also be red and swollen. A stinging sensation in the throat or difficulty swallowing, called “dysphagia,” may develop. Some people may develop a white, shiny coating or white patches on their tongue, inside of the cheeks or on the floor of the mouth. This symptom may indicate a yeast infection, also called “thrush” or “oral candidiasis.”

Patients who experience any of these symptoms, or other changes in the mouth or throat, can be helped by prescription medications and other remedies that will make them more comfortable.

Some ways to manage mouth and throat side effects:

- Visit the dentist before treatment begins, if possible.
- Maintain good dental and oral hygiene to help prevent gum disease and infection, including the use of prescribed mouthwash.
- Inspect your mouth daily to detect any problems.
- Contact your healthcare team if you have pain or discomfort.
- Seek the advice of your healthcare team for oral hygiene tips and dietary suggestions to reduce or relieve discomfort.

**Diarrhea.** This is a side effect of some anticancer drugs, caused by the drug’s effect on normal cells in the GI tract. If it occurs, it should be treated as soon as possible.

**Constipation.** This can also be a side effect of treatment. Certain drugs may intensify this problem in people who tended to be constipated before treatment. Older people and those with low-fiber diets may be at greater risk.

Constipation and diarrhea can be managed. Patients should keep track of daily bowel habits and notify their healthcare providers right away if cramping, gas, loose stools, diarrhea or constipation begins. For diarrhea, physicians may prescribe antidiarrheal medication, antibiotics, intravenous fluids or changes in diet. It may also help to drink water. Liquids to avoid may include coffee, caffeinated tea, alcohol and milk. For constipation, physicians may recommend laxatives, intravenous fluids or changes in diet. Drinking warm or hot fluids, especially in the morning, may be helpful.

**Nausea and Vomiting.** These are side effects resulting from direct irritation to the GI tract and from stimulation to an area of the brain that affects the GI tract. People often associate nausea and vomiting with chemotherapy. Yet there are many anticancer drugs that do not always cause these side effects. Nausea and vomiting are drug- and dose-dependent side effects that vary in occurrence and severity among patients. Sometimes, nausea and vomiting subside as a person adjusts to the treatment. When needed, there are anti-nausea drugs (called “antiemetics”) that healthcare providers can prescribe to prevent or minimize this side effect. Acupuncture has been evaluated in a number of studies and is now recognized as a safe method for managing chemotherapy-associated nausea and vomiting that may be effective for some patients. Therapeutic massage may be effective in reducing cancer treatment-related nausea for some patients.

## The Liver and Kidneys

**Liver.** Patients with preexisting liver disease may require dosage reductions for drugs that are metabolized in the liver or excreted into the bile. Some agents may be toxic to the liver; the patient’s physician may obtain periodic blood samples to check for possible liver damage.

**Kidneys.** Many drugs are excreted through the kidneys. Patients with preexisting kidney damage or impaired kidney function may need drug-dosage modifications. The patient’s physician will obtain blood tests to assess kidney function before starting therapy to determine if dosage reductions are necessary.

## The Skin, Hair and Nails

**Rashes.** Skin-related side effects include dry skin, redness, itchiness or skin lesions that can occur with some drugs during or after treatment. Treatment for these side effects can make patients more comfortable and may prevent serious problems from developing. Skin changes should be evaluated as soon as possible. They can sometimes be related to primary disease or infection. A medical consultation can determine appropriate treatment including topical solutions (creams, lotions or gels) to soothe, soften or moisturize the skin or to relieve itching.



**Hair Loss.** Some anticancer drugs can also cause hair loss by interfering with the normal growth of hair follicle cells. However, this is temporary, and hair growth resumes when the drugs are stopped or decreased in dosage.

Some suggestions for coping with hair loss:

- Wash hair and scalp every few days, using a mild, moisturizing shampoo.
- Drugs that affect the hair shaft will cause hair to fall out whether or not it is combed. However, combing hair during periods of hair loss will prevent tangles.
- Some people with long hair decide to get a short haircut or shave their heads before hair loss begins.
- Patients who are planning to buy a wig can cut a portion of hair prior to hair loss so that color and texture can be matched more easily.
- Some people who have hair loss choose not to wear wigs. Bandannas, hats or scarves may be worn to keep the head warm.
- Mineral oil can be applied to the scalp to ease dryness.

**Fingernails and Toenails.** Chemotherapy can affect the color and texture of fingernails and toenails. Nails may darken, crack or become brittle. Some patients develop white ridges or bands of discoloration along the nails or develop a darkening of the nail bed. A small number of patients receiving chemotherapy partially or completely lose their fingernails and toenails. Any changes to the nails should be discussed with the patient's healthcare team.

In all cases it is important to keep fingernails and toenails clean, dry and relatively short. Except in extremely rare cases, a patient's nails will grow back or return to normal after chemotherapy ends.

## **Blood Cells**

Blood cells are formed in the marrow, which occupies the center of the bones. Blood-forming stem cells in the marrow mature into the three types of blood cells: white cells, red cells and platelets. Red cells carry oxygen to all parts of the body. White cells have several functions, but one of the most important is to prevent and fight infection. Platelets prevent bleeding and form plugs that help stop bleeding after an injury to a blood vessel. Developing blood cells remain in the marrow until they are mature enough to perform these vital functions and are then released into the circulation.

People undergoing cancer therapy may have low blood-cell counts. Many chemotherapy drugs affect the rapidly dividing marrow cells. This causes a

decrease in the marrow's ability to supply new cells to the circulating blood for a period of time during and after treatment. The white cell counts decrease most quickly, followed by the platelets and then the red cells.

The degree to which drug therapy will affect the marrow depends on whether the marrow is already damaged by the cancer before treatment, on the type and duration of the drugs used and on other factors. Some drugs have little or no damaging effect on the marrow, while others have definite effects that can be reversed quickly once the therapy is stopped. Still other drugs have effects on the marrow that can last for several weeks.

Physicians measure the patient's blood-cell counts periodically during drug therapy to see if red cell, white cell or platelet counts are decreased. The level of the blood counts will help the physician decide how well the treatment is working, whether the dosage requires adjusting or whether the patient may need a transfusion of new blood cells during the treatment (see the Society's free fact sheet *Understanding Blood Counts* for more information).

During a course of treatment and blood-cell measurements, the term "nadir" may be used. This term refers to the approximate point when the cells in the blood are at their lowest number, based on the drug used. One drug may have a nadir of 7 to 14 days. This means that 7 to 14 days after beginning chemotherapy, the white cells, red cells and platelets will be at their lowest point. Once this period is over, the blood counts usually will rise to safe or normal levels.

**Risk of Infection.** White cells in the blood help the body fight infection. Anticancer drugs may destroy both the cancer cells and the healthy, infection-fighting cells, thereby decreasing the body's ability to fight infection. Moderate decreases in white cells create little increased risk and do not require special precautions, especially if the cells return toward normal within a short period of time. However, a severe or prolonged low white cell count may occur, especially after intensive drug therapy, and may increase the patient's risk of developing an infection.

Medical staff will take precautions to avoid exposing patients to bacteria, viruses and other infection-causing agents, such as by practicing frequent and vigorous hand-washing. They may also wear masks, gowns and gloves in some circumstances. Caregivers for patients with catheters need to be meticulous in the cleaning of the catheter to reduce the risk of bacteria infecting the body through this device.

Patients getting anticancer therapy as outpatients should discuss with their healthcare provider how to avoid infection.

Some strategies to reduce your risk of infection:

- People in treatment and those around them should wash their hands frequently and thoroughly throughout the day, including before eating and before and after using the bathroom.
- Avoid people with contagious diseases such as colds, flu, measles or chickenpox.
- Avoid crowds.
- Do not get any immunization shots without checking first with your physician.
- Avoid people who recently have received immunizations with live attenuated organisms or viruses (weakened forms of the organism or virus that causes the disease), such as vaccines for measles. Patients should check with their healthcare provider about which vaccines are important and how long to stay away.
- Clean the rectal area gently but thoroughly after each bowel movement. Ask the healthcare team for advice if irritation occurs or hemorrhoids become a problem. Also, check with the healthcare team before using enemas or suppositories.
- Do not cut or tear the cuticles of the nails.
- Take care to avoid cuts or nicks when using scissors, needles or knives.
- Use an electric shaver instead of a razor to prevent cuts.
- Use an extra soft toothbrush that will not hurt the gums.
- Do not squeeze or scratch pimples.
- Take a warm (not hot) bath, shower or sponge bath every day. Pat skin dry using a light touch. Do not rub.
- Use lotion or oil to soften and heal skin if it becomes dry and cracked.
- Clean cuts and scrapes right away with warm water, soap and an antiseptic.
- Wear protective gloves when gardening or cleaning up after animals and others, including young children.
- Avoid uncooked fruits and vegetables if a very low white cell count persists for a period of time. Check with the healthcare team for diet and nutrition advice.

Patients should report signs of infection to their physicians immediately. Be alert to the signs and symptoms of infection such as:

- Fever of 100.5°F or greater
- Chills
- Sweating
- Loose bowels
- A burning feeling when you urinate
- A severe cough or sore throat
- Unusual vaginal discharge or itching
- Redness, swelling or tenderness, especially around a wound, sore, pimple, IV catheter site or vascular access device
- Abdominal pain.

Do not use aspirin, acetaminophen or any other medicine to reduce a fever without checking with the physician.

**Anemia.** Anticancer drugs may destroy developing cells in the marrow and cause a decrease in red cell count. People with a low red cell count are said to be “anemic” and may have several side effects, including:

- Fatigue or shortness of breath, especially with physical activity
- Pale skin, gums or nails
- Lightheadedness or dizziness
- A tendency to feel cold.

Many people who have a mild or moderate decrease in red cells, especially if the decrease is gradual, will not realize that they are anemic. Any of the symptoms described above should be reported to the physician. In some cases, physicians will prescribe a red cell growth factor or, if needed, a blood transfusion to help restore the patient’s red cell count.

**Bleeding.** Anticancer drugs may cause a decrease in platelets. A mild or moderate decrease usually does not cause bleeding. However, people with a severely low platelet count can experience the following side effects:

- Excessive bleeding from cuts or bruises
- Pinhead-sized bleeding points in the skin, called petechiae, especially on the lower legs and ankles

- Black and blue spots on the skin from minor bumps or in the absence of any injury
- Reddish or pinkish urine
- Black or bloody bowel movements
- Bleeding from the gums or nose
- Headaches
- Dizziness
- Weakness
- Pain in joints and muscles.

Once therapy is stopped and the platelet count is restored to a sufficient level, these side effects rapidly fade. However, if a patient needs to receive additional drug therapy and the platelet count remains very low, transfusions of platelets may be required.

Some ways to avoid problems if the platelet count is low are:

- Certain medications can weaken the platelets and worsen bleeding problems. Take medicines only with medical advice, including aspirin, acetaminophen, ibuprofen or other over-the-counter or prescribed medicines.
- Do not drink alcoholic beverages without medical advice.
- Use an extra soft toothbrush. Follow medical and dental advice for caring for teeth and gums or for having dental work while in treatment and after treatment ends.
- Blow gently into a soft tissue to clean the nose.
- Take care to avoid cuts or nicks from scissors, needles, knives or tools.
- Take care to avoid burns when ironing or cooking. Use a padded glove when cooking or baking.
- Avoid contact sports and other activities that might result in injury.
- Use an electric shaver instead of a razor.

**Growth Factors and Cytokines.** The body naturally makes substances that stimulate blood-cell production. These natural substances, called “cytokines,” have been identified through research and synthesized into drugs that

stimulate blood-cell production. Synthetic cytokines called “growth factors” can be given to people undergoing cancer treatment to help increase specific types of blood cells. Examples of these drugs are shown in the following table.

<b>Types of Growth Factors</b>	
Epoetin alfa (Procrit®,EpoGen®)	Helps stimulate red cell production
Darbepoetin alfa (Aranesp®)	A longer-acting form of epoetin alfa; helps stimulate red cell production; requires less-frequent injections.
Granulocyte colony stimulating factor (G-CSF) filgrastim (Neupogen®) or pegfilgrastim (Neulasta®)	Helps stimulate white cell production
Granulocyte-macrophage colony stimulating factor (GM-CSF) sargramostim (Leukine®)	Helps stimulate white cell production

Growth factors can help some patients’ blood-cell counts to recover faster than they would without treatment. If the body does not produce enough red cells, severe anemia can occur. Growth factors that stimulate red cell production may be used to treat severe anemia in patients receiving cancer therapy.

Granulocyte colony stimulating growth factor and granulocyte-macrophage colony stimulating growth factor help the marrow to make new white cells. They are used to prevent or reduce the risk of infection while patients are being treated with certain therapies that affect the white cells that fight infection. They may also be used to help the marrow recover after marrow transplantation and stem cell transplantation. Colony stimulating growth factors may cause mild bone pain, usually in the lower back or pelvis, about the time the white cells start to come back in the marrow. This mild pain lasts only a few days. The physician can prescribe a painkiller for the patient to take during that time.

Physicians exercise caution when prescribing these medications for people with cancer that involves the bone marrow, because growth factors might stimulate cancer cell growth.

Cytokines are also being studied for their potential usefulness in improving the recovery of platelet counts.

## Thrombosis

Some patients may be predisposed to a condition called “deep vein thrombosis” (DVT). Factors that increase the risk of DVT are certain drugs, relative immobility or the systemic effects of cancer, or tumors that compress veins. DVT occurs especially in the leg veins but occasionally in other locations. Preventive actions such as leg exercises and supportive hose may be used. In addition to the local effects of obstructed veins, there is a risk of embolism to the lungs, called “pulmonary embolism.” This involves the breaking off of venous clots that can lodge in the smaller lung arteries and may cause lung damage. Early diagnosis is important so that anticoagulants or other therapies can be used.

## Fatigue

Fatigue affects many individuals with blood cancer. People with cancer-related fatigue may feel its effects for days, weeks or months. It is an important issue that can have a major impact on quality of life, with physical, emotional and economic consequences. The reasons so many people with cancer feel fatigue are under study. However, there are steps that people can take to feel better. Medical treatment, moderate exercise, good nutrition, stress management and certain lifestyle changes help many patients feel more energetic or better able to deal with fatigue. For comprehensive information, see the Society’s free fact sheet *Fatigue*.

## Dental Issues

Dental care is an important part of overall cancer care. Treatment should involve a dentist or a dental oncologist (a dentist who is specially trained to treat people with cancer). Patients should update their medical history records with their dentists to include cancer diagnosis and treatments, and provide their dentist and oncologist with each other’s name and telephone number for consultation. Patients may be advised to have any necessary major dental procedures completed prior to beginning therapy if possible. Patients with mouth, teeth or jaw pain – or any other symptom of possible dental problems – should speak with their oncologist and dentist as soon as possible.

**Osteonecrosis of the jaw (ONJ).** This is an uncommon but serious condition that has occurred in some cancer patients receiving bisphosphonates such as pamidronate (Aredia®) or zoledronic acid (Zometa®). Although no cause and effect relationship between bisphosphonate therapy and osteonecrosis has been established, it is suspected.

ONJ may develop when the jaw fails to heal after minor trauma such as a tooth extraction that results in bone exposure. Symptoms include pain, swelling, poor healing or infection of the gums, loosening of teeth, or numbness or a feeling of heaviness in the jaw. Some factors that may increase the risk of ONJ are radiation therapy to the head or neck, chemotherapy, steroid therapy, anemia (low red cell count), infection, poor dental health, alcohol abuse or cigarette smoking, poor nutrition, poor blood circulation or clotting problems.

Treatment with bisphosphonates should be managed by an experienced oncologist, with close coordination between the oncologist and oral surgeon and/or a dental specialist. A dental examination before patients begin therapy with intravenous bisphosphonates is advisable if possible. Dental treatments and procedures that require bone healing should be completed before initiating intravenous bisphosphonate therapy. Patients should receive and follow instructions on maintaining good oral hygiene and having regular dental assessments. For patients currently receiving bisphosphonates who require dental procedures, there is no current evidence to suggest that interrupting bisphosphonate therapy will prevent or lower the risk of ONJ. Frequent clinical assessments and conservative dental management are suggested for these patients. Treatment of patients who develop ONJ may include frequent clinical assessments, antibiotics, oral rinses and removable mouth appliances. Minor dental work may be necessary to remove injured tissue and reduce sharp edges of the bone. Surgery is typically avoided because it may make the condition worse.

## **Peripheral Neuropathy**

Peripheral neuropathy is the term for damage to nerves of the peripheral nervous system, which transmits information from the brain and spinal cord to every other part of the body. There are several causes for this condition – it can be inherited or acquired, and it can be a side effect of certain anticancer drugs including vincristine, vinblastine, bortezomib, thalidomide or lenalidomide. Symptoms may include temporary (or in some cases ongoing) numbness, tingling, burning, coldness or weakness in the arms or legs. Patients should seek medical advice as soon as possible if they experience these symptoms.

## **Food and Nutrition**

Eating well during and after cancer therapy helps people cope with side effects, fight infection, rebuild healthy tissues and maintain their weight and energy. People living with cancer have different nutrition goals and challenges, depending on their age, type of disease and treatment and stage of treatment. Side effects that interfere with good nutrition can be managed, enabling patients to get the nutrients they need to tolerate and recover from treatment,



prevent weight loss and maintain general health. People undergoing cancer therapy may not feel like eating because of the side effects of cancer or cancer treatment, including perceived changes in the taste and smell of food; mouth, throat or GI effects (dry mouth, nausea, diarrhea, constipation); infections; fatigue; or depression. These side effects can be managed in a number of ways.

#### Some Nutrition Tips:

- Eat frequent, small meals or snacks, perhaps four to six times a day.
- Keep prepared snacks or small meals on hand.
- Have liquids such as juices, soups or shakes if eating solid foods is a problem; fluids can provide calories and nutrients.
- Choose soft foods or foods that can be cooked until tender.
- Cut foods into bite-sized pieces or grind or blend them so that less chewing is needed.
- For extra calories, blend cooked foods or soups with high-calorie liquids such as gravy, milk, cream or broth instead of water.
- Try new foods and recipes to accommodate changes in taste or smell.
- When possible, take a walk before meals to improve appetite.
- Eat with friends or family members when possible. When eating alone, listen to the radio or watch TV.
- Accept help with food shopping and meal preparation.

Protein foods (chicken, fish, meat, soy products and eggs) help the body rebuild tissues that may be harmed by drug therapy. Low-fat dairy products like milk, cottage cheese and yogurt also supply a good amount of protein and calcium, along with other important vitamins and minerals. Whenever possible and in accordance with medical advice, eat a variety of foods including fruits, vegetables and whole grains on a daily basis.

Ask the physician for a referral to a dietitian/nutritionist to discuss specific nutrition needs. Ask about any special diet restrictions for specific foods and liquids. Ask if you need to avoid foods or liquids that may carry harmful bacteria, including raw fruits and vegetables. Carefully follow health guidelines for safe food handling, including keeping hands and food-preparation surfaces clean, cooking food at proper temperatures, refrigerating food promptly and keeping raw meat, poultry, seafood and eggs and their juices away from ready-to-eat foods.

Patients who cannot eat well for extended periods of time may be prescribed supplements that are high in calories and protein or IV nutrition until they can resume normal eating.

**Weight Gain.** This may occur as a result of increased appetite or fluid retention associated with certain drug therapies. Weight-loss diets are not recommended without medical advice. Patients may be advised to switch to a lower fat diet (less butter, margarine, oil; lean meats only) or a low-sodium diet. Seek the advice of a nutritionist or dietitian. If needed, ask the oncologist for a referral.

## Older Adults

About 50 percent of all blood cancers develop in patients older than 60 years. On average, the ability to tolerate intensive chemotherapy decreases with age, even in otherwise healthy older persons. In addition, unrelated illnesses occurring in older people are more frequent, including diabetes mellitus, coronary artery disease, congestive heart failure, impaired kidney function and others. These conditions may limit the drugs and dosages of drugs that can be administered to certain patients, potentially compromising their treatment. Also, studies have shown that certain complications, such as posttherapy infection, are more frequent in older patients.

However, age is just one factor that guides treatment options. Physicians are using a series of relatively simple tests that provide better predictive information about tolerance for therapy than calendar age alone. In many cases, older patients can receive full dosages of the appropriate therapy. Newer agents, targeted to the specific cancer and sparing of normal tissue in certain situations (such as imatinib mesylate [Gleevec®] and dasatinib [Sprycel™] for chronic myelogenous leukemia) are well tolerated by older patients. Mylotarg® (gemtuzumab ozogamicin) is another targeted therapy for older adults with relapsed acute myelogenous leukemia. Mylotarg® is a monoclonal antibody attached to a cell toxin that acts as a chemotherapy agent. Also, certain blood-cell growth stimulators, such as G-CSF, can be used to increase the tolerance of older patients to chemotherapy, making it possible for more patients to receive appropriate therapy.

## Social and Emotional Issues

Hearing the words “You have cancer” may make a person feel like life has changed completely in an instant. It may help to know that after diagnosis, many people with cancer do survive, live many years of good quality life and continue to, or learn to, live their lives to the fullest. Most people with cancer are able to cope with what at first may seem too hard to accept. Acceptance usually takes time. Knowing more about your disease and treatment may make

it easier. Patients may first want to focus on learning about their disease and its treatment. Then they can look ahead to taking care of themselves and to remission and recovery.

Discuss side effects with the physician. Also communicate about fears, concerns and your symptoms. Ask questions. Physicians will prescribe medicine or suggest other ways to help ease side effects.

There are many sources of help available to patients and families. Aspects of cancer care such as making treatment choices and finding the time and money for medical care are stressful. Contact the Society or ask the healthcare team for guidance and referrals to other sources of help.

Depression is an illness that should be treated even when a person is undergoing treatment for cancer. It is important to seek medical advice if a patient's mood does not improve over time – for example, if a patient is feeling depressed most of every day for the past two weeks. Treatment for depression has proven benefits for people living with cancer. For more information about depression and cancer, contact the Society and see the National Institute of Mental Health fact sheet at [www.nimh.nih.gov/publicat/NIMHdepcancer.pdf](http://www.nimh.nih.gov/publicat/NIMHdepcancer.pdf).

Cancer affects everyone in the family. Children with cancer may feel frightened and helpless but may be too young to fully understand their illness and its implications and treatment. They may be dealing with absence from school, separation from friends and an inability to participate in certain activities, such as sports – at least for a time. It is also hard for children with a sick brother, sister, parent or grandparent, or other close relative or friend. The parents of a child with cancer are dealing with discipline issues as well as new time commitment and financial issues related to their child's illness. Ask the healthcare team for help and guidance, not only for medical concerns but also for any emotional issues relating to the disease and its treatment.

For more support information, see the Leukemia & Lymphoma Society's free booklets:

*Emotional Aspects of Childhood Blood Cancers: A Handbook for Parents;* 2006.

*Coping: Support for People Living with Leukemia, Lymphoma or Myeloma;* 2005.

*Each New Day: Ideas for Coping with Leukemia, Lymphoma or Myeloma;* 2006.

*Touching Lives – A Directory of Patient Services Programs;* 2005.

# Part 3: Potential Side Effects of Individual Drugs

## Types of Drugs

There are several types of drugs; each type interferes with a cell's ability to grow or survive in a different way. The choice of drugs used to treat a patient's disease depends on the patient's disease type, age, stage of disease, response to previous treatment and other factors. Patients with acute myelogenous leukemia, myeloma or Hodgkin lymphoma may each be treated with different agents. Also, patients with the same disease are sometimes treated with different agents depending on what the physician thinks is the best treatment for each patient.

Many standard cancer treatments and treatments that are being studied in clinical trials combine drugs that work in different ways to destroy cancer cells. Different anticancer drugs attack cancer cells at specific critical points in their growth cycles, making therapy more effective. This approach also reduces the chance that the cancer cells will become resistant to the drugs. As a result, there has been an increase in the number of patients who achieve either very long-term remissions or cures. However, some blood cancers are treated effectively with a single agent.

**Drug Resistance.** Sometimes cancer cells may be resistant to the initial drugs used or may become resistant to the drugs after a period of time. In this case, the physician may prescribe different drugs to fight the cancer cells.

Table 1 provides a brief description of drug types and lists examples of drugs within each type.

**Table 1. Some Drugs Used in Blood Cancer Treatment**

**Antimetabolites and Hypomethylating Agents**

Chemicals that are very similar to the building blocks of DNA or RNA; these agents mimic substances that the cancer cell needs to build DNA and RNA. They are changed from the natural chemical sufficiently that when the cancer cell uses the antimetabolite instead of the natural substances, it cannot produce normal DNA or RNA and the cell dies. Azacitidine and decitabine are considered to have their primary effect as hypomethylating agents.

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|---|---|
| <ul style="list-style-type: none"> <li>• Azacitidine (Vidaza®)</li> <li>• Cladribine (Leustatin®, 2-CdA)</li> <li>• Clofarabine (Clolar®)</li> <li>• Cytarabine (cytosine arabinoside, ara-C; Cytosar-U®)</li> <li>• Decitabine (Dacogen®)</li> </ul> | <ul style="list-style-type: none"> <li>• Fludarabine (Fludara®)</li> <li>• Hydroxyurea (Hydrea®, Droxia®)</li> <li>• Methotrexate</li> <li>• 6-mercaptopurine (Purinethol®)</li> <li>• 6-thioguanine, thioguanine (Tabloid®)</li> </ul> |
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**Antitumor Antibiotics**

Drugs that interact directly with DNA in the nucleus of cells, prevent the DNA from functioning normally, and often kill the cancer cell.

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|---|--|
| <ul style="list-style-type: none"> <li>• Bleomycin (Blenoxane®)</li> <li>• Daunorubicin (Cerubidine®)</li> <li>• Doxorubicin (Adriamycin®, Rubex®)</li> </ul> | <ul style="list-style-type: none"> <li>• Idarubicin (Idamycin®)</li> <li>• Mitoxantrone (Novantrone®)</li> </ul> |
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**Biomodifiers**

Drugs based on natural products with exact mechanisms of action that are unclear.

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|---|--|
| <ul style="list-style-type: none"> <li>• Interferon Alfa-2a (Roferon®-A)</li> </ul> | <ul style="list-style-type: none"> <li>• Interferon Alfa-2b (Intron® A)</li> </ul> |
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**Bisphosphonates**

Drugs that are used to help reduce the advancement of bone disease, decrease bone pain and reduce fractures. Bisphosphonates work by inhibiting the activity of bone-destroying cells called “osteoclasts.”

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|---|---|
| <ul style="list-style-type: none"> <li>• Pamidronate (Aredia®)</li> </ul> | <ul style="list-style-type: none"> <li>• Zoledronic acid (Zometa®)</li> </ul> |
|---|---|

### Cell-Maturing Agents

Drugs that act on a type of leukemia to induce maturation of leukemic cells

- Arsenic trioxide (Trisenox®)

- Tretinoin (all-trans retinoic acid [ATRA]), Vesanoïd®)

### DNA-damaging Agents (Antineoplastics) and Alkylating Agents

A number of drugs act against cancer cells by interacting with the DNA of the cancer cell, causing the cancer cells to be destroyed or preventing them from growing. There are four chemotherapy drug types that act directly to impair the DNA in cancer cells: the DNA-damaging agents (also called “antineoplastics”), antitumor antibiotics, antimetabolites and DNA-repair enzyme inhibitors.

- Busulfan (Myleran®, Busulfex®)
- Carboplatin (Paraplatin®)
- Carmustine (BCNU; BiCNU®)
- Chlorambucil (Leukeran®)
- Cisplatin (Platinol®)
- Cyclophosphamide (Cytoxan®, Neosar®)

- Dacarbazine (DTIC-Dome®)
- Ifosfamide (Ifex®)
- Lomustine (CCNU; CeeNU®)
- Mechlorethamine (nitrogen mustard; Mustargen®)
- Melphalan (Alkeran®)
- Procarbazine (Matulane®)

### DNA-Repair Enzyme Inhibitors

These drugs attack the cancer cell proteins (enzymes) in the cell nucleus that normally repair any damage to the DNA. Repair of DNA damage is a normal and vital process in the cell. Without this repair process, the cancer cell is much more susceptible to damage and is prevented from growing.

- Etoposide (VP-16; VePesid®, Etopophos®, Toposar®)

- Teniposide (VM-26; Vumon®)
- Topotecan (Hycamtin®)

### Drugs That Prevent Cells From Dividing by Blocking Mitosis

Drugs that damage cancer cells by blocking a process called mitosis (cell division), preventing the cancer cells from dividing and multiplying.

- Vinblastine (Velban®)

- Vincristine (Oncovin®)

### Enzymes That Prevent Cells From Surviving

- Asparaginase (Elspar®)

- Pegaspargase (PEG-L asparaginase; Oncaspar®)

### **Histone Deacetylase Inhibitor**

An agent that attacks cancer cells by targeting the proteins that support DNA in the cell nucleus.

- Vorinostat (Zolinza™)

### **Hormones (Glucocorticoids) That Can Kill Lymphocytes**

In high doses these synthetic hormones, relatives of the natural hormone cortisol, can kill malignant lymphocytes. The way these drugs work is under study; however, it is thought that they may block cell metabolism through their effect on specific genes.

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| <ul style="list-style-type: none"><li>• Dexamethasone (Decadron®)</li><li>• Methylprednisolone (Medrol®)</li></ul> | <ul style="list-style-type: none"><li>• Prednisone</li></ul> |
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### **Immunomodulators**

Agents that modify or influence the functions of the immune system. Immune modulators may be immunosuppressants or immunostimulators.

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|--|---|
| <ul style="list-style-type: none"><li>• Lenalidomide (Revlimid®)</li></ul> | <ul style="list-style-type: none"><li>• Thalidomide (Thal o mid®)</li></ul> |
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### **Monoclonal Antibodies**

Agents made specifically to attach to the surface of cancer cells to interfere with the cell's function and destroy the cell. Some monoclonal antibodies are linked to a toxin or radioactive substance. The antibody and the toxin or radioactive substance work together to destroy the cancer cell.

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|--|---|
| <ul style="list-style-type: none"><li>• Alemtuzumab (Campath®)</li><li>• Gemtuzumab ozogamicin (Mylotarg®)</li></ul> | <ul style="list-style-type: none"><li>• Rituximab (Rituxan®)</li><li>• yttrium-90-ibritumomab tiuxetan (Zevalin®)</li></ul> |
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### **Proteasome Inhibitor**

An agent designed to limit the effects of a cell structure called a “proteasome,” which regulates cell processes by breaking down certain proteins that are involved in energy production and other aspects of the cell cycle. When a proteasome does not function properly, the cell dies. Cancer cells may be more susceptible to the effects of proteasome inhibition than normal cells.

- Bortezomib (Velcade®)

## Tyrosine Kinase Inhibitors

Agents that block a specific mutant protein that initiates the malignant cell transformation.

• Imatinib mesylate (Gleevec®)

• Dasatinib (Sprycel®)

*Combinations of these drugs and drug groups often form the basis of treatment.*

*This table does not include every approved drug or drug under study in clinical trials.*

## Approved Therapies and Cancer Clinical Trials

Many of the drugs and drug combinations listed in this section are approved therapies (also referred to as “indicated”) for specific blood cancers. The U.S. Food and Drug Administration approves a treatment if it meets safety requirements and is more effective than an existing standard treatment or equally effective but has fewer toxic side effects. Safety and effectiveness are determined as a result of “clinical trials.”

A cancer clinical trial is a carefully controlled research study conducted by physicians to improve the care and treatment of cancer patients. Before a clinical trial begins, a new therapy is often developed and tested in a laboratory. Then it is thoroughly tested in animals. If the early research (the “preclinical trials”) shows the therapy is safe and effective, a carefully planned and monitored clinical trial of the drug or treatment, with three or four parts called “phases,” will be conducted in people. Phase I is conducted in a small group of patients to determine safety, appropriate dosage and administration of a treatment. In phase II, the treatment is tested in a larger group of patients to determine whether and how well it works; researchers also continue to monitor safety in phase II and throughout the trial. The trial will move into phase III if the results of phase II studies are positive. A “study treatment group” will be compared to a “control treatment group”; control-group patients will receive the best standard treatment. A treatment that “passes” phase III testing may be approved by the FDA if it is found to be both safe and more effective than standard treatment or equally as effective as standard treatment with fewer toxic side effects. Phase IV studies are often performed on treatments that have already been FDA approved; their purpose is to identify additional uses, gather more information from a larger group of patients regarding safety and effectiveness or establish effectiveness in a patient subgroup, such as patients over the age of 65.



Advances in treatment for these blood cancers depend on clinical trials of new therapies or new combinations of therapies. FDA-approved drugs are sometimes used to treat conditions outside of existing approval guidelines. This occurs when physicians and researchers have a clear, scientific basis for testing the therapy to evaluate and monitor its effectiveness to treat patients with other conditions. This is sometimes called “off-label usage.” Patients who receive this type of therapy should be treated as part of a clinical trial. This enables the medical and scientific community to determine which treatments are effective, based on such factors as disease type or subtype, cytogenetics, disease stage and patient age.

Some patients may consider all treatment opportunities including clinical trials before making a choice about treatment. Others may look for a cancer clinical trial if standard treatment is not working. Patients and their physicians can decide if and when a clinical trial is the right course to take.

The Leukemia & Lymphoma Society’s Information Resource Center (IRC) Information Specialists can assist patients and healthcare providers with clinical trial searches that take into account disease type, location and treatment history. This service is also available on the Society’s Web site, [www.LLS.org](http://www.LLS.org). It includes National Cancer Institute clinical trial listings as well as pharmaceutical company-sponsored trials. Please call the IRC at (800) 955-4572 or visit our Web site. Information Specialists can also answer general questions about diagnosis and treatment options and offer guidance and support.

For more information, please see the Society’s free booklet, *Understanding Clinical Trials for Blood Cancers*.

## Individual Drug Listings

Normal body cells may be affected by drugs used to treat blood cancers. Some of these drug side effects may be serious. Other drug side effects, such as hair loss, may not be serious but may cause concern.

Patients should ask their healthcare providers to tell them which side effects are considered to be urgent. The side effects listed for each of the drugs on the following pages may require prompt medical attention. When in doubt, call the physician or oncology nurse clinician.

## Table 2: What to Tell the Physician

### **Whenever a drug is prescribed, before starting the drug tell the physician whether the patient:**

- Has taken this drug before (even if there was no unusual reaction).
- Has had an unusual or allergic reaction to this drug.
- Has or has had any other medical conditions, including diabetes, gout, heart disease (or abnormal heart rhythms or congestive heart failure), head injury, history of alcoholism, infection, immune deficiencies, kidney disease or kidney stones, liver disease, marrow depression, low serum magnesium or potassium, or pancreatitis (inflammation of the pancreas).
- Has recently been exposed to varicella (chickenpox) or herpes zoster (shingles).
- Has had an unusual or allergic reaction to any foods, such as lactose or egg whites, preservatives, dyes, *E coli*-derived roteins, albumin or retinoid preparations (Vitamin A).
- Has ever been treated with radiation therapy or other cancer therapies; some drugs used to treat cancers may increase the total effects of other medications and/or radiation therapy.
- Takes any other medications or drugs (prescription or over-the-counter). “Street drugs” may increase the toxicity of certain cancer drugs.
- Is a smoker.
- Takes any vitamins, minerals, herbs or other supplements.

### **In addition:**

#### **Certain medications may affect test results and/or treatment decisions.**

- Inform all of the patient’s other healthcare providers, including dentists or emergency room staff, whether the patient is taking any of the medications listed on the following pages.

#### **Certain medications can have fertility, reproductive or lactation effects.**

- Patients (men and women) should discuss fertility, pregnancy and birth control issues (including if pregnancy occurs during treatment) with their healthcare providers; women should discuss breast-feeding, if relevant.

### Table 3: What to Ask the Physician

#### Your Treatment and Its Side Effects

- Why do I need this treatment?
- What are the benefits/risks associated with this treatment?
- What side effects, if any, should be reported immediately? (When in doubt, call the physician or oncology nurse right away.)
- What are other possible side effects of this treatment?
- When are side effects likely to occur?
- What can I do to relieve the side effects?
- Are there any complementary or alternative methods you can suggest to reduce the side effects of this treatment?
- Do I need to be concerned about pregnancy/ breastfeeding/sterility?
- (For women) Will this drug have any effect on my menstrual cycle?
- Will I have any special nutritional needs? Are there any known food-drug interactions of my treatment? Are there any foods I cannot eat?
- Do I need to consume extra fluids while taking this medication?
- Can I drink alcoholic beverages, including beer and wine?
- Should I be aware of any test results that could be affected by this drug?
- Are there any known drug-drug interactions of my treatment?
- Are there any other possible treatment methods for my type of cancer?
- Are there any clinical trials for my type of cancer?
- How many treatments will I receive?
- What drug or drugs will I be taking?
- How will the drugs be given?
- Where will I get my treatment?
- How long will each treatment last?
- Do I have a choice about when to begin treatment?
- Do I have a choice about which days or time of day to schedule my treatment?
- Will I need assistance the day of my treatment?

### **Table 3: What to Ask the Physician (*cont'd.*)**

- Are there signs or symptoms I will need to watch for after I finish treatment with this drug? For what period of time?
- Will I be able to work/go to school while I'm undergoing treatment?
- Will this drug cause drowsiness or have any effect on my alertness? Can I drive or do jobs that require me to be alert?
- Do I need to take any special precautions to avoid sunlight or tanning beds while taking this drug?

#### **Taking Medication at Home**

- What if I miss a dose?
- What if I vomit immediately after taking my medication?
- Is it safe to drink alcohol during my use of this drug?
- When should I take the medication?
- How should I store it?
- Do I need to take this medication with food?

#### **Contacting Medical Staff**

- When and how should I contact the healthcare team with questions?
- How do I contact a healthcare professional after hours?

#### **Tips for Keeping Track of Information From Your Healthcare Provider**

- Bring a friend, family member or caregiver to sit with you. This person can help you understand what your physician says during your visit and help refresh your memory afterward.
- Ask for any printed information that is available on your cancer and treatment.
- You, or the person who goes with you, may want to take notes during your appointment.
- Ask your physician to slow down when you need more time to write.
- Keep a healthcare diary or calendar.

You may want to ask if you can use a tape recorder during your visit. Take notes from the tape after the visit is finished. That way, you can review your conversation later as many times as you wish.

The headings for each of the drug entries that follow are:

<b>Generic name</b>	<b>Pronunciation</b>
<b>Common brand name(s)/Common names</b>	<b>Drug category</b>
<b>Method of administration</b>	

The drug listings in this section are general descriptions. Changes in medical practice make it impossible to certify the precise accuracy of such complex material. Confirmation of this information from other sources, especially one's physician, is necessary.

Package inserts for many FDA-approved drugs can be accessed online through the National Library of Medicine (NLM) at <http://dailymed.nlm.nih.gov>. Additional drug information from NLM is available at <http://www.nlm.nih.gov/medlineplus/medicines.html>.

Patients and caregivers may also contact The Leukemia & Lymphoma Society's Information Resource Center (IRC) to speak with an Information Specialist at (800) 955-4572 or visit the Society's Web site at [www.LLS.org](http://www.LLS.org).

<b>Alemtuzumab</b>	<b>a-LEM-tooz-a-mab</b>
<b>Campath®</b>	<b>Monoclonal antibody</b>
<b>Given by intravenous (IV) injection</b>	

Alemtuzumab is used to treat B-cell chronic lymphocytic leukemia (B-CLL) patients whose disease has progressed, despite prior use of other chemotherapeutic agents.

**Side Effects Needing Medical Attention:** Fever or chills; cough or hoarseness; back, lower back or side pain; painful or difficult urination; bleeding or bruising; black, tarry stools; blood in urine or stools; pinhead-sized red spots on skin; diarrhea; dizziness; faintness, or lightheadedness when getting up from a lying or sitting position; headache; itching, hives or rash; nausea and vomiting; pale skin; shortness of breath; sore throat; sores, ulcers or white spots on lips or in mouth, or swelling or inflammation of the mouth; sudden sweating; swollen glands; tightness in chest; troubled breathing after exertion; unusual tiredness or weakness; wheezing; acid or sour stomach; bone pain; burning, crawling, itching, numbness, prickling, "pins and needles," or tingling feelings; lack or loss of strength; loss of appetite; muscle aches; painful cold sores or blisters on lips, nose, eyes or genitals; sleeplessness; stomach discomfort, upset or pain; weight loss.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Arsenic Trioxide</b>	AR-sen-ik try-OX-ide
Trisenox®	Cell-maturing agent
Given by intravenous (IV) injection	

Arsenic trioxide is used as second-line treatment of relapsed or refractory acute promyelocytic leukemia. It is used to treat certain other types of blood cancers in patients who have not responded to other medications. Arsenic trioxide seems to interfere with the growth of cancer cells, which are then eventually destroyed by the body.

**Side Effects Needing Medical Attention:** Chills; convulsions (seizures); cough; confusion; decreased urine output; dry mouth; eye pain; general feeling of illness; headache; increased thirst; irregular heartbeat; joint pain; loss of appetite; mood changes; muscle pain or cramps; nausea or vomiting; numbness or tingling in hands, feet or lips; shortness of breath or trouble breathing; sore throat; unusual tiredness or weakness; diarrhea; acid or sour stomach; back pain; bloating or swelling of face, hands, lower legs and/or feet; bone pain; constipation; flushing; heavy nonmenstrual vaginal bleeding; itchy, red skin; injection site pain, redness or swelling; itching; limb pain; depression; neck pain; nosebleeds; pale skin; shivering chills; trouble sleeping or getting to sleep; weight gain.

<b>Asparaginase</b>	a-SPARE-a-gin-ase
Elspar®	Enzymes that prevent cells from surviving
Given by intravenous (IV) or intramuscular (IM) injection	

Asparaginase is used to treat acute lymphocytic leukemia. It may also be used to treat patients with certain types of cancers of the lymph system.

**Side Effects Needing Medical Attention:** Difficulty in breathing; joint pain; puffy face; rash or itching; stomach pain (severe) with nausea and vomiting; fever or chills; inability to move arm or leg; unusual bleeding or bruising; confusion; drowsiness; lower back or side pain; hallucinations (seeing, hearing or feeling things that are not there); depression; nervousness; sores in the mouth or on lips; swelling of feet or lower legs; tiredness; unusually frequent urination; unusual thirst; seizures; severe headache.

**Side Effects Needing Medical Attention After Stopping This Medication:** Severe headache; inability to move arm or leg; severe stomach pain with nausea and vomiting.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Azacitidine</b>	ay-za-SITE-i deen	
Vidaza®		Antimetabolite
Given by injection		

Azacitidine is used for treatment of certain myelodysplastic syndrome subtypes and chronic myelomonocytic leukemia.

**Side Effects Needing Medical Attention:** Black, tarry stools; bladder pain; bleeding gums; blood in urine or stool; cloudy urine; body aches or pain; burning or stinging of skin; chest pain or tightness in the chest; chills; ear, nose or chest congestion; cough; diarrhea; difficulty breathing, shortness of breath or wheezing; difficulty swallowing; dizziness; fast heartbeat; fever; frequent urge to urinate; headache; hives; hoarseness; itching; loss of voice or voice changes; lower back or side pain; muscle aches; nausea or vomiting; pain or tenderness around eyes and cheekbones; painful cold sores or blisters on lips, nose, eyes or genitals; painful or difficult urination; pain, redness, swelling, tenderness or warmth on skin; pale skin; pinhead-sized red spots on skin; puffiness or swelling of the eyelids or around the eyes, face, lips or tongue; rapid heartbeat; sore throat; sores, ulcers, or white spots on lips or in mouth; swollen glands; tender, swollen glands in neck; troubled breathing with exertion; unusual bleeding or bruising; unusual tiredness or weakness.

<b>Bexarotene</b>	beks-AIR-oh-teen	
Targretin®		Antineoplastic
Given by mouth or applied to the skin		

Bexarotene is used to treat cutaneous T-cell lymphoma (CTCL). It may be used after other drugs have been tried and the tumor is still a problem.

**Side Effects Needing Medical Attention:** (Note: When this medication is applied to the skin, in general these side effects are less common.) Bloating or swelling of face, hands, lower legs and/or feet; chills, fever or general feeling of discomfort or illness; decreased urination or painful or difficult urination; lack or loss of strength; rapid or unusual weight gain; tingling or “pins and needles” sensation; sore throat; swollen, painful or tender lymph glands in neck, armpit or groin; unusual bruising; unusual tiredness or weakness; abnormal or excessive sweating; blistering, burning, crusting, dryness, flaking, itching, rash, scaling, severe redness, soreness, or sticky or tacky sensation of the skin; swelling or thickening of skin or lesion; headache; increased cough.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Bleomycin</b>	blee-oh-MYE-sin
Blenoxane®	Antitumor antibiotic
Given by intravenous (IV) or intramuscular (IM) injection	

Bleomycin is used to treat certain types of lymphomas. Bleomycin may cause a temporary loss of hair in some people. Normal hair growth should return (although it may take several months) after treatment ends.

**Side Effects Needing Medical Attention:** Cough; shortness of breath.

<b>Bortezomib</b>	bor-TEZ-oh-mib
Velcade®	Proteasome inhibitor
Given by injection	

Bortezomib is used to treat myeloma in patients who have received at least one prior therapy that has not helped. It may also be used to treat mantle cell lymphoma.

**Side Effects Needing Medical Attention:** Black, tarry stools; bleeding gums; blood in urine or stool; blurred vision; body aches or pain; burning, crawling, itching, numbness, prickling, “pins and needles,” or tingling feelings; chest pain or tightness in chest; chills; confusion; faintness or lightheadedness when getting up from a lying or sitting position suddenly; cough; decreased urination; difficult or labored breathing or shortness of breath; dry mouth; fainting; fever; headache; increase in heart rate; loss of voice; lower back or side pain; nasal or ear congestion or runny nose, sneezing or sore throat; pale skin; painful or difficult urination; painful blisters on trunk of body; pinhead-sized red spots on skin; rapid breathing; sunken eyes; sweating; excessive thirst; troubled breathing with exertion; ulcers, sores or white spots in mouth; unsteadiness or awkwardness; unusual bleeding or bruising; unusual tiredness or weakness; weakness in arms, hands, legs or feet; wheezing.

<b>Busulfan</b>	byoo-SUL-fan
Myleran®, Busulfex®	DNA-damaging agent
Taken by mouth	

Busulfan is used to treat certain blood cancers and may also be used before stem cell transplantation for chronic myelogenous leukemia (CML).

**Side Effects Needing Medical Attention:** Fever, chills, or sore throat; unusual bleeding or bruising; cough; joint pain; shortness of breath; swelling of feet or lower legs; black, tarry stools; blood in urine or stool; pinhead-sized red spots on skin; lower back or side pain; painful or difficult urination; sores in mouth and on lips; darkening of the skin; confusion; diarrhea; dizziness; loss of appetite; nausea and vomiting; unusual tiredness; weakness; weight loss.

Read the General Information at the beginning of this chapter for important information that applies to this drug.



**Side Effects Needing Medical Attention After Stopping This Medication:**

Fever, cough, shortness of breath; unusual bleeding or bruising; black, tarry stools; blood in urine or stool; chills; hoarseness; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin.

<b>Carboplatin</b>	KAR-boe-pla-tin
Paraplatin®	DNA-damaging agent
Given by intravenous (IV) injection	

Carboplatin is used to treat certain kinds of cancer, including some blood cancers. Carboplatin may cause temporary loss of hair during treatment. Normal hair growth should return after treatment ends.

**Side Effects Needing Medical Attention:** Black, tarry stools; blood in urine or stools; cough or hoarseness; fever or chills; lower back or side pain accompanied by fever or chills; numbness or tingling in fingers or toes; pain at the site of injection; painful or difficult urination accompanied by fever or chills; pinhead-sized red spots on skin; rash or itching; unusual bleeding or bruising; unusual tiredness or weakness; nausea and vomiting; constipation or diarrhea; loss of appetite. Some side effects of carboplatin (especially blood problems or numbness or tingling in fingers or toes) may be more likely to occur in the elderly.

<b>Carmustine</b>	kar-MUS-teen
BicNU®/BCNU	DNA-damaging agent
Given by intravenous (IV) injection	

Carmustine can be used to treat myeloma (in combination with prednisone), relapsed or refractory Hodgkin lymphoma (as secondary therapy in combination with other approved drugs), relapsed or refractory non-Hodgkin lymphoma (as secondary therapy in combination with other approved drugs) or Waldenström macroglobulinemia.

**Side Effects Needing Medical Attention:** Carmustine may damage some tissues and cause scarring around the injection site if it seeps out of the vein into which it is injected. Tell your healthcare provider immediately if you notice redness, pain, or swelling at the injection site. Other side effects needing medical attention are cough; fever; chills; sore throat; shortness of breath; unusual bleeding or bruising; flushing of face; sores in mouth and on lips; unusual tiredness or weakness; swelling of feet or lower legs; unusual decrease in urination; black, tarry stools; blood in urine or stool; hoarseness; lower back or side pain; painful or difficult urination; or pinhead-sized red spots on skin. Side effects that affect the lungs (for example, cough and shortness of breath) may be more likely in smokers. Other possible side effects are nausea and vomiting (usually lasting no longer than 4 to 6 hours); discoloration of

Read the General Information at the beginning of this chapter for important information that applies to this drug.

skin along the vein of injection; diarrhea; difficulty in swallowing; difficulty in walking; dizziness; loss of appetite; rash itching.

**Side Effects Needing Medical Attention After Stopping This Medication:**

Cough; fever; chills; sore throat; shortness of breath; unusual bleeding or bruising; black, tarry stools; blood in urine or stool; hoarseness; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin.

<b>Chlorambucil</b>	klor-AM-byoo-sill
Leukeran®	DNA-damaging agent
Taken by mouth	

Chlorambucil is used to treat certain blood cancers.

**Side Effects Needing Medical Attention:** Convulsions; cough; fever; chills; sore throat; flank or stomach pain; shortness of breath; rash; sores in the mouth and on the lips; swelling of feet or lower legs; unusual bleeding or bruising; yellowing of eyes and skin; black, tarry stools; blood in urine or stool; hoarseness; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin; agitation; blisters; hallucinations (seeing, hearing or feeling things that are not there); muscle twitching; peeling or scaling of skin; tremors; trouble walking; weakness (severe) or paralysis; changes in menstrual periods; itching of skin; nausea and vomiting.

**Side Effects Needing Medical Attention After Stopping This Medication:**

Cough; fever; chills; sore throat; shortness of breath; unusual bleeding or bruising; black, tarry stools; blood in urine or stool; pinhead-sized red spots on skin; diarrhea; dizziness; faintness or lightheadedness when getting up from a lying or sitting position; headache; itching, hives or rash; nausea and vomiting; pale skin; painful or difficult urination; sores, ulcers or white spots on lips or in mouth, or painful cold sores or blisters on lips, nose, eyes or genitals; sudden sweating; swollen glands; tightness in chest; troubled breathing after exertion; unusual tiredness or weakness; wheezing; back pain; bone pain; burning, crawling, itching, numbness, prickling, “pins and needles” or tingling feelings; heartburn; lack or loss of strength; loss of appetite; muscle aches; sleeplessness; stomach discomfort, upset or pain, or acid or sour stomach; swelling or inflammation of the mouth; weight loss.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Cisplatin</b>	sis-PLA-tin
Platinol®, Platinol®-AQ	DNA-damaging agent
Given by intravenous (IV) injection	

Cisplatin is used to treat certain types of cancer.

**Side Effects Needing Medical Attention:** If cisplatin accidentally seeps out of the vein into which it is injected, it may damage some tissues and cause scarring. Tell your healthcare provider right away if you notice redness, pain or swelling at the place of injection. Other side effects needing medical attention: black, tarry stools; blood in urine or stool; cough or hoarseness accompanied by fever or chills; dizziness or faintness (during or shortly after a dose); fast heartbeat (during or shortly after a dose); fever or chills; lower back or side pain accompanied by fever or chills; painful or difficult urination accompanied by fever or chills; pinhead-sized red spots on skin; swelling of face (during or shortly after a dose); unusual bleeding or bruising; wheezing (during or shortly after a dose); joint pain; loss of balance; ringing in ears; swelling of feet or lower legs; trouble hearing; unusual tiredness or weakness; convulsions (seizures); loss of reflexes; loss of taste; numbness or tingling in fingers or toes; trouble walking; nausea and severe vomiting; loss of appetite. Hearing problems and loss of balance are more likely to occur in children, who are usually more sensitive to the effects of cisplatin.

<b>Cladribine</b>	CLAD-rah-been
Leustatin® / 2-CdA	Antimetabolite
Given by intravenous (IV) injection	

Cladribine is used to treat hairy cell leukemia and Waldenström macroglobulinemia.

**Side Effects Needing Medical Attention:** Black, tarry stools; blood in urine or stool; hoarseness; lower back or side pain; painful or difficult urination or unusual decrease in urination; pinhead-sized red spots on skin or rash; fever; chills; cough; shortness of breath; unusual bleeding or bruising; unusual tiredness or weakness; pain or redness at site of injection; stomach pain; swelling of feet or lower legs; unusually fast heartbeat; fatigue; nausea; decreased appetite; vomiting; diarrhea; constipation; headache; itching; muscle or joint pain; sweating; trouble sleeping; weakness.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Clofarabine</b>	kloe-FAR-a-been
Clolar®	Antimetabolite
Given by injection	

Clofarabine is used to treat pediatric patients 1 to 21 years old with relapsed or refractory acute lymphoblastic leukemia after at least two prior regimens.

**Side Effects Needing Medical Attention:** Black, tarry stools; bleeding gums; blood in urine or stool; blurred vision; burning or stinging of skin; chest pain; chills; clay-colored stools; confusion; cough or hoarseness; dark urine; decreased urine output; diarrhea; difficult or labored breathing, irregular breathing, shortness of breath or rapid, shallow breathing; dilated neck veins; dizziness, faintness, or lightheadedness when getting up from a lying or sitting position suddenly; facial swelling; fainting; fast, pounding or irregular heartbeat or pulse; fever; headache; itching; loss of appetite; lower back or side pain; nausea; nervousness; painful cold sores or blisters on lips, nose, eyes or genitals; painful or difficult urination; pale skin; pinhead-sized red spots on skin; pounding in the ears; rash with flat lesions or small, raised lesions on the skin; slow or fast heartbeat; sore throat; sores, ulcers or white spots on lips or in mouth; stomach pain; sweating; swelling; swollen glands; tightness in chest; troubled breathing with exertion; unpleasant breath odor; unusual bleeding or bruising; unusual tiredness or weakness; vomiting; vomiting of blood; warmth on skin; weight gain; wheezing; yellow eyes or skin.

<b>Cyclophosphamide</b>	sy-kloe-FOSS-fa-mide
Cytoxan®	DNA-damaging agent
May be given by mouth or by injection	

Cyclophosphamide is used to treat certain blood cancers. Cyclophosphamide may cause a temporary loss of hair in some people. After treatment has ended, normal hair growth should return, although the new hair may be a slightly different color or texture.

**Side Effects Needing Medical Attention:** If the patient is receiving this medicine by injection: redness, swelling or pain at the place of injection. All recipients: blood in urine; dizziness, confusion or agitation; fever; chills; sore throat; missed menstrual periods; tiredness; cough; side or stomach pain; joint pain; shortness of breath; swelling of feet or lower legs; unusual bleeding or bruising; unusually fast heartbeat; black, tarry stools; sores in mouth and on lips; painful, difficult or unusually frequent urination; excessive thirst; yellow eyes and skin; pinhead-sized red spots on skin or rash; darkening of skin and fingernails; loss of hair; nausea or vomiting (if severe); diarrhea; redness of face; headache; sweating; itching; swollen lips.

**Side Effects Needing Medical Attention After Stopping This Medication:** Blood in urine.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Cytarabine</b>	sy-TARE-a-been	
Cytosar-U®/cytosine arabinoside, ara-C		Antimetabolite
Given by injection		

Cytarabine is used to treat certain types of blood cancers. This medicine may cause a temporary loss of hair in some people. After treatment with cytarabine has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Fever, chills; sore throat; unusual bleeding or bruising; side or stomach pain; joint pain; numbness or tingling in fingers, toes or face; sores in mouth and on lips; swelling of feet and lower legs; tiredness; black, tarry stools; bone or muscle pain; chest pain; cough; difficulty in swallowing; fainting spells; general feeling of body discomfort or weakness; heartburn; irregular heartbeat; pain at the place of injection; reddened eyes; shortness of breath; rash; unusual decrease in urination or painful or difficult urination; yellowing of eyes and skin; lower back pain; pinhead-sized red spots on skin; loss of appetite; nausea and vomiting; dizziness; headache; itching; skin freckling.

**Side Effects Needing Medical Attention After Stopping This Medication:** Fever and chills; sore throat; unusual bleeding or bruising; black, tarry stools; blood in urine or stool; cough; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin.

<b>Dacarbazine</b>	da-KAR-ba-zeen	
DTIC-Dome®		DNA-damaging agent
Given by intravenous (IV) injection		

Dacarbazine is used to treat certain types of blood cancers. It may cause a temporary loss of hair in some people. After treatment with dacarbazine has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** If dacarbazine accidentally seeps out of the vein, it may damage some tissues and cause scarring. Your healthcare provider should be notified right away if redness, pain or swelling is noticed at the IV site. Other side effects needing medical attention: fever; chills; sore throat; unusual bleeding or bruising; sores in mouth and on lips; black, tarry stools; blood in urine or stool; lower back, side or stomach pain; painful or difficult urination; pinhead-sized red spots on skin; shortness of breath; swelling of face; yellow eyes; loss of appetite; nausea or vomiting (should lessen after 1 or 2 days); flushing or muscle numbness in face.

**Side Effects Needing Medical Attention After Stopping This Medication:** Fever; chills; sore throat; unusual bleeding or bruising; black, tarry stools; blood in urine or stool; cough; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Darbepoetin Alfa</b>	dar-be-POE-e-tin AL-fa
Aranesp®	Antianemic
Given by intravenous (IV) injection	

Darbepoetin alfa stimulates the marrow to produce red cells. It is used to treat severe anemia in patients receiving chemotherapy. Darbepoetin alfa only corrects anemia. It has no direct effect on cancer cells.

**Side Effects Needing Medical Attention:** Abdominal or stomach pain; accumulation of pus; arm, back or jaw pain; blurred vision; breathing difficulties (irregular, noisy, troubled at rest), shortness of breath or rapid breathing; discomfort, tightness or heaviness in chest; chest pain; confusion; difficulty in speaking (slow speech or inability to speak); double vision; chills; cough-producing mucus; decrease in amount of urine; diarrhea; dilated neck veins; dizziness; fainting or lightheadedness; fast, slow or irregular heartbeat; fatigue or tiredness (extreme or unusual); fever; headache; nausea or vomiting; pain, tenderness, swelling or warmth over injection site; pounding in the ears; rapid or pounding pulse; skin discoloration at injection site; sweating; swelling of ankles, face, fingers, feet, hands or lower legs; unconsciousness; weight gain; wheezing; constipation; general feeling of discomfort or illness; lack or loss of strength; loss of appetite; muscle aches, pains or stiffness; pain in joints; shivering; sore throat; trouble sleeping.

<b>Dasatinib</b>	da-SAT-in-ib
Sprycel®	Tyrosine kinase inhibitor
Taken by mouth	

Dasatinib is a medicine used to treat chronic myelogenous leukemia (CML) or a type of acute lymphocytic leukemia (ALL) called Philadelphia chromosome positive or Ph+ ALL in some patients who are no longer benefiting from treatment with the current available therapies for these diseases, including Gleevec® (imatinib mesylate) or who experience severe side effects from Gleevec®.

**Special Considerations:** Tell your doctor if you have any other medical conditions, especially if you have a liver or heart problem or are lactose intolerant.

**Side Effects Needing Medical Attention:** Fever; bleeding or easy bruising; swelling; weight gain; increasing shortness of breath.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Daunorubicin</b>	daw-noe-ROO-bi-sin	
<b>Cerubidine®</b>		<b>Antitumor antibiotic</b>
<b>Given by intravenous (IV) injection</b>		

Daunorubicin is used in combination with other approved anticancer drugs for remission induction in acute leukemia (myelogenous, monocytic, erythroid) of adults and for remission induction in acute lymphocytic leukemia of children and adults. Daunorubicin causes urine to turn reddish in color, which may stain clothes. This is not blood. It is perfectly normal and lasts for only 1 or 2 days after each dose is given. This medicine often causes a temporary and total loss of hair. After treatment with daunorubicin has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** If daunorubicin accidentally seeps out of the vein, it may damage some tissues and cause scarring. Your healthcare provider should be notified if redness, pain, or swelling is noticed at the IV site. Also requiring attention are irregular heartbeat; shortness of breath; swelling of feet and lower legs; fever; chills; sore throat; sores in mouth and on lips; side or stomach pains; joint pain; unusual bleeding or bruising; itching; black, tarry stools; blood in urine or stool; cough or hoarseness; lower back pain; painful or difficult urination; pinhead-sized red spots on skin or rash; nausea or vomiting (mild); darkening or redness of the skin; diarrhea.

**Side Effects Needing Medical Attention After Stopping This Medication:** Irregular heartbeat; shortness of breath; swelling of the feet and lower legs.

<b>Decitabine</b>	De-SIT-a-been	
<b>Dacogen®</b>		<b>Antimetabolite</b>
<b>Given by intravenous (IV) injection</b>		

Decitabine is an injectable medicine used to treat adults with myelodysplastic syndrome (MDS).

**Side Effects Needing Medical Attention:** Signs of an allergic reaction (hives, difficulty breathing, swelling of the face, lips, tongue or throat); fever, chills, body aches or other flulike symptoms; unusual bleeding or bruising; pale skin; unusual weakness; white patches or sores inside the mouth or on the lips; swelling in the hands, ankles or feet.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Denileukin Diftitox</b>	DEN-i-loo-kin DIF-ti-toks
Ontak®	Antineoplastic
Given by intravenous (IV) injection	

Denileukin diftitox is used to treat cutaneous T-cell lymphoma.

**Side Effects Needing Medical Attention:** Back pain or lower back pain or side pain accompanied by fever or chills; chest pain; dizziness or faintness; difficulty swallowing; fast or irregular heartbeat; fever or chills; infection; rash; shortness of breath; swelling of face, feet or lower legs; warmth and flushing of skin; severe abdominal pain; black, tarry stools; cloudy urine; blood in urine or stool; cough or hoarseness accompanied by fever or chills; severe headache; loss of coordination; painful or difficult urination accompanied by fever or chills; pain in groin or leg; pinhead-sized red spots on skin; slurring of speech; sudden vision changes; swelling or pain at injection site; unusual bleeding or bruising; weakness of arms or legs; difficulty swallowing; loss of strength or energy; nausea; pain in joints and muscles; unusual tiredness or weakness; vomiting; cough; diarrhea; sore throat; trouble sleeping.

<b>Doxorubicin</b>	dox-oh-ROO-bi-sin
Adriamycin® PFS, Adriamycin® RDF, Rubex®	Antitumor antibiotic
Given by intravenous (IV) injection or infusion	

Doxorubicin is used to treat some kinds of blood cancer. Doxorubicin causes the urine to turn reddish in color, which may stain clothes. This is not blood. It is perfectly normal and lasts for only 1 or 2 days after each dose is given.

**Side Effects Needing Medical Attention:** If doxorubicin accidentally seeps out of the vein, it may damage some tissues and cause scarring. The doctor or nurse should be notified right away if you notice redness, pain or swelling at the IV site; unusually fast or irregular heartbeat; shortness of breath; swelling of feet and lower legs; wheezing; fever; chills; sore throat; sores in mouth and on lips; side or stomach pains; joint pain; unusual bleeding or bruising; rash or itching; loss of hair; nausea and vomiting (if severe); blood in urine or stools; darkening of soles, palms or nails; diarrhea.

**Side Effects Needing Medical Attention After Stopping This Medication:** Irregular heartbeat; shortness of breath; swelling of feet and lower legs.

Read the General Information at the beginning of this chapter for important information that applies to this drug.



<b>Epoetin Alfa</b>	eh-POO-ee-tin AL-fas
Procrit®, Epogen®/EPO	Antianemic
Given by injection	

Epoetin alfa is a synthetic version of human erythropoietin (EPO). EPO is produced naturally in the body, mostly by the kidneys. It stimulates the marrow to produce red blood cells. Epoetin alfa is used to treat severe anemia caused by certain cancers or cancer treatments.

**Side Effects Needing Medical Attention:** Chest pain; convulsions (seizures); shortness of breath; fast heartbeat; headache; increased blood pressure; fever; swelling of the face, fingers, ankles, feet or lower legs; vision problems; weight gain; influenza-like reaction, with symptoms such as muscle aches, bone pain, chills, shivering, and sweating; diarrhea; muscle weakness (severe); nausea or vomiting; tiredness.

<b>Etoposide</b>	e-toe-POE-side
Etopophos®/VePesid®/VP-16	DNA-repair enzyme inhibitor
Given by mouth or intravenous (IV) injection	

Etoposide is used to treat certain types of cancer. This medicine often causes a temporary loss of hair. After treatment with etoposide has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Fever; chills; sore throat; sores in mouth or on lips; unusual bleeding or bruising; difficulty walking; numbness or tingling in fingers and toes; pain at the site of injection; rapid heartbeat; shortness of breath or wheezing; weakness; black or tarry stools; blood in urine or stool; back, lower back or side pain; pinhead-sized red spots on skin or rash; itching; sweating; swelling of face or tongue; tightness in throat; loss of appetite; hair loss; nausea and vomiting; diarrhea; unusual tiredness.

<b>Fludarabine</b>	flu-DARE-a-been
Fludara®	Antimetabolite
Given by intravenous (IV) injection	

Fludarabine is used to treat chronic lymphocytic leukemia (CLL). This drug works by blocking a natural enzyme needed by the cancer cell to build DNA or RNA. The damaged cells are then destroyed by the body. This medicine may rarely cause a temporary loss of hair in some people. After treatment with fludarabine has ended, normal hair growth should return.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

**Side Effects Needing Medical Attention:** Cough; sore throat; fever; chills; sores or white patches on mouth or lips; unusual bleeding or bruising; fatigue; chest pain; shortness of breath; pain or burning on urination; lower back or side pain; black, tarry stools; blood in urine; pinhead-sized red spots on skin; agitation or confusion; blurred vision; loss of hearing; numbness or tingling in fingers, toes or face; swelling of feet or lower legs; unusual tiredness or weakness; nausea and vomiting; diarrhea; hair loss; aching muscles; general feeling of discomfort or illness; headache; loss of appetite.

**Side Effects Needing Medical Attention After Stopping This Medication:** Cough or hoarseness; fever or chills; loss of vision; lower back or side pain; painful or difficult urination; shortness of breath or wheezing; weakness; black, tarry stools; blood in urine or stool; back, lower back or side pain; pinhead-sized red spots on skin or rash; itching; sweating; swelling of face or tongue; tightness in throat; loss of appetite; hair loss; nausea and vomiting; diarrhea; unusual tiredness.

<b>Gemtuzumab ozogamicin</b>	gem-TOO-ze-mab oh-zoh-GAM-ih-sin
Mylotarg®	Monoclonal antibody
Given by injection	

Gemtuzumab ozogamicin is a monoclonal antibody to which the cell toxin calicheamicin is attached. It is used to treat acute myelogenous leukemia and other types of blood cancers that have recurred in patients who are 60 years of age or older.

**Side Effects Needing Medical Attention:** Black, tarry stools; bloating or swelling of face, arms, hands, lower legs or feet; blood in urine or stools; bluish color of fingernails, lips, skin, palms or nail beds; blurred vision; burning or stinging of skin; chest pain; chills; confusion; convulsions (seizures); cough or hoarseness; cracked lips; decrease or increase in urine or pain, difficulty or burning while urinating; diarrhea; difficulty in swallowing; dizziness; dry mouth; excessive sweating; fainting; fast or slow or other irregular heartbeat; fever; flushed, dry skin; fruitlike breath odor; headache (sudden and severe); heavy, nonmenstrual vaginal bleeding; inability to speak; increased thirst or hunger; large, flat, blue or purplish patches in the skin or other rash; lightheadedness; lower back, joint or side pain; loss of appetite; mood changes; muscle pain, cramps or stiffness; muscle trembling or twitching; nausea or vomiting; numbness or tingling in hands, feet or lips; painful cold sores or blisters on lips, nose, eyes or genitals, or sores, ulcers or white spots on lips, tongue or inside of mouth; pale skin; persistent bleeding or oozing from puncture sites, mouth or nose; palpitations; pounding in the ears; rapid, shallow breathing; severe or continuing dull nervousness; shortness of breath; slurred speech; sore throat; stomachache; sweating; swelling or inflammation of the mouth, face, fingers, feet or lower legs; swollen glands;

Read the General Information at the beginning of this chapter for important information that applies to this drug.

temporary blindness; tightness in chest; tingling of hands or feet; troubled breathing on exertion; unexplained nosebleeds; unusual bleeding or bruising; unusual tiredness or weakness; unusual weight gain or loss; weakness in arm and/or leg on one side of the body (sudden and severe); wheezing; yellow eyes or skin; acid or sour stomach; difficulty in moving; dry, red, hot or irritated skin; full or bloated feeling or pressure in the stomach; lack or loss of strength; muscle pain, swelling or redness in joints; swelling of abdominal or stomach area; trouble sleeping.

### Glucocorticoids

<b>Dexamethasone</b>	dex-a-METH-a-zone	
Decadron®		Glucocorticoid, antiemetic
Taken by mouth		

<b>Hydrocortisone</b>	hy-dro-KOR-ti-zone	
Commonly referred to by generic name		Glucocorticoid, antiemetic
Given by intravenous (IV), intramuscular (IM) or subcutaneous (SC) injection, or taken by mouth		

<b>Prednisone</b>	PRED-ni-sone	
Commonly referred to by generic name		Glucocorticoid, antiemetic
Taken by mouth		

Glucocorticoids are used to treat many medical problems, including some kinds of cancer.

**Side Effects Needing Medical Attention:** Swelling of feet and ankles; muscle weakness; ulcers or stomach pain or burning; easy bruising; wounds that are slow to heal; dizziness; severe headaches; menstrual problems; blood-sugar problems; blurred or decreased vision or seeing halos around lights; sore throat and fever; depression; mood or mental changes; indigestion; sleeplessness; nervousness or restlessness; weight gain.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

## Granulocyte Colony-Stimulating Growth Factor

**Filgrastim, pegfilgrastim** (fil-GRA-stim), (PEG-fil-gra-stim)

Neupogen®/G-CSF, Neulasta®/G-CSF Hematopoietic stimulant, antineutropenic

## Granulocyte-Macrophage Colony-Stimulating Growth Factor

**Sargramostim** (sar-GRAM-oh-stim)

Leukine®/GM-CSF Hematopoietic stimulant, antineutropenic

Given by injection

Filgrastim and sargramostim are synthetic versions of substances naturally produced in your body and used to prevent or reduce the risk of infection for patients being treated with certain cancer medicines that affect the infection-fighting white cells. Colony stimulating growth factors may also be used to help the marrow recover after stem cell transplantation.

**Side Effects Needing Medical Attention:** For filgrastim: redness or pain at the site of subcutaneous (under the skin) injection; fever; rapid or irregular heartbeat; sores on skin; wheezing; headache; pain in arms or legs; pain in joints or muscles; pain in lower back or pelvis; rash or itching. For sargramostim: fever; redness or pain at the site of subcutaneous injection; shortness of breath; swelling of feet or lower legs; weight gain (sudden); chest pain; rapid or irregular heartbeat; sores on skin; wheezing; headache; pain in arms or legs; pain in joints or muscles; pain in lower back or pelvis; rash or itching; dizziness or faintness after first dose of medicine; flushing of face after first dose of medicine; weakness.

**Hydroxyurea** hye-DROX-ee-yoo-REE-ah

Hydrea®, Droxia® Antimetabolite

Taken by mouth

Hydroxyurea is used to treat some kinds of blood cancers. Hydroxyurea may cause temporary loss of hair in some people. After treatment has ended, normal hair growth should return, although the new hair may be a slightly different color or texture.

**Side Effects Needing Medical Attention:** Fever; chills; sore throat; sores in mouth and on lips; unusual bleeding or bruising; convulsions; unusual tiredness or fatigue; dizziness; side or stomach pain; hallucinations (seeing, hearing or feeling things that are not there); headache; joint pain; confusion; diarrhea; constipation; drowsiness; redness of face; loss of appetite; nausea; vomiting.

**Side Effects Needing Medical Attention After Stopping This Medication:** Black, tarry stools; blood in urine; cough or hoarseness; fever or chills; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin; unusual bleeding or bruising.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Ibritumomab Tiuxetan</b>	eye-bri-TOO-mo-mab tee-ux-EH-tan
<b>Zevalin®</b>	<b>Monoclonal antibody, immunoconjugate</b>
<b>Given by intravenous (IV) injection as a radioimmunotherapy</b>	

Ibritumomab tiuxetan is given in conjunction with rituximab (Rituxan®); see the information about rituximab that appears later in this section. Ibritumomab tiuxetan is used along with another monoclonal antibody (rituximab) and two radioactive pharmaceuticals (In-111 and Y-90) to treat relapsed or refractory low-grade, follicular or transformed B-cell non-Hodgkin lymphoma.

**Side Effects Needing Medical Attention:** Rash; fever; weakness; headache; dizziness; shortness of breath; coughing; unusual tiredness or fatigue; unusual bruising or bleeding; itching; flushing; muscle or joint pain; abdominal pain; nausea; vomiting; diarrhea.

**Side Effects Needing Medical Attention After Stopping This Medication:** Bleeding gums; blurred vision; bone pain; chills; confusion; cough; coughing up blood; difficulty in breathing or swallowing; rapid, shallow breathing or shortness of breath; dizziness; fainting; fast heartbeat; fever; headache (sudden and severe); inability to speak; increased menstrual flow or vaginal bleeding; lightheadedness; lower back or side pain; nosebleeds; painful or difficult urination; pale skin; paralysis; prolonged bleeding from cuts or unusual bleeding or bruising; red or dark brown urine; red or black, tarry stools; seizures; slurred speech; sore throat; temporary blindness; ulcers, sores or white spots in mouth; unusual tiredness or weakness; weakness in arm and/or leg on one side of body (sudden and severe).

<b>Idarubicin</b>	eye-dah-ROO-bah-sin
<b>Idamycin®</b>	<b>Antitumor antibiotic</b>
<b>Given by intravenous (IV) injection</b>	

Idarubicin is used to treat certain types of acute leukemia.

**Side Effects Needing Medical Attention:** If idarubicin accidentally seeps out of the vein, it may damage some tissues and cause scarring. Your healthcare provider should be notified right away if you notice redness, pain or swelling at the IV site; irregular heartbeat; chest pain; severe bleeding or unusual bleeding or bruising; shortness of breath; fever; chills; sore throat; sores in mouth and on lips; stomach pains; rash, itching or hives; nausea and vomiting (mild); diarrhea; headache.

**Side Effects Needing Medical Attention After Stopping This Medication:** Irregular heartbeat; shortness of breath; swelling of feet and legs.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Ifosfamide</b>	eye-FOSS-fah-mide
Ifex®	DNA-damaging agent
Given by intravenous (IV) injection	

Ifosfamide is used to treat acute lymphocytic leukemia. It may cause temporary loss of hair in some people. After treatment has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Convulsions; blood in urine; painful urination; dizziness; fever; chills; sore throat; yellow discoloration of skin or eyes; cough; shortness of breath; sores on mouth or lips; missed menstrual periods; stomach pain; joint pain; swelling of feet or lower legs; unusual bleeding or bruising.

**Side Effects Needing Medical Attention After Stopping This Medication:** Blood in urine.

<b>Imatinib Mesylate</b>	i-MAT-in-ib MES-i-late
Gleevec®	Tyrosine kinase inhibitor
Given by mouth	

Imatinib mesylate is used to treat chronic myelogenous leukemia (CML) and a subtype of acute lymphocytic leukemia (ALL) called Philadelphia chromosome positive or Ph+ ALL.

**Side Effects Needing Medical Attention:** Black, tarry stools; bleeding problems; bloating or swelling of face, hands, lower legs and/or feet; chest pain; chills; cough; decreased urination or painful or difficult urination; fever; pale skin; rapid weight gain; weight loss; shortness of breath or trouble breathing on exertion; sore throat; sores, ulcers or white spots on lips or in mouth; swollen glands; unusual tiredness or weakness; convulsions (seizures); dry mouth; increased thirst; irregular heartbeat; loss of appetite; mood changes; muscle pain or cramps; nausea and vomiting; numbness or tingling in hands, feet or lips; small red or purple spots on skin or rash; tightness in chest; wheezing; bone pain; increased bowel movements; loose stools; bloody nose; constipation; headache; joint pain; night sweats; acid indigestion; itchy skin; upset stomach.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Interferon Alfa-2a</b>	in-ter-FEER-on AL-fa-two-ay
Roferon®-A	Biomodifier
Given by intramuscular (IM) or subcutaneous (SC) injection	

Interferons are substances naturally produced by cells in the body to help fight infections and tumors. They may also be synthetic versions of these substances. Interferon alfa 2-a is used to treat hairy cell leukemia and certain chronic leukemias. It may cause a temporary loss of hair. After treatment has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Depression, anxiety or other mental changes; difficulty breathing or shortness of breath; chest pain; numbness or tingling in fingers, toes or face; rapid heartbeat with or without fever; rash; dizziness; flulike symptoms (such as fever, fatigue, muscle, joint or bone pain, headache, chills); sweating; cough; sore throat; swelling of feet or ankles; difficulty walking; unusual tiredness or fatigue; loss of appetite; changes in taste; nausea and vomiting; weight loss; diarrhea or stomach pain.

<b>Interferon Alfa-2b</b>	in-ter-FEER-on AL-fa two-bee
Intron® A	Biomodifier
Given by intramuscular (IM) or subcutaneous (SC) injection	

Interferons are substances naturally produced by cells in the body to help fight infections and tumors. They may also be synthetic versions of these substances. Interferon alfa-2b is used to treat hairy cell leukemia and follicular non-Hodgkin lymphoma. Interferon may cause a temporary loss of hair. After treatment has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Rapid heartbeat; difficulty breathing or shortness of breath; chest pain; depression; flulike symptoms (such as fever, fatigue, muscle, joint or bone pain, headache, chills); rash; sweating; dizziness; numbness or tingling in fingers and toes; cough; sore throat; confusion; anxiety; muscle weakness; loss of appetite; nausea; vomiting; diarrhea; stomach pain; weight loss; changes in taste; dry mouth; increased thirst.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Lenalidomide</b>	le-na-LID-oh-mide
Revlimid®	Antianemic, antiangiogenesis agent, immunomodulator
Taken by mouth	

Lenalidomide is a medicine used to treat patients with myeloma who have received at least one prior therapy and have a certain type of myelodysplastic syndrome (MDS) called 5q MDS. Patients with this type of MDS may have low red blood cell counts that require blood transfusions.

**Side Effects Needing Medical Attention:** Arm or leg swelling; black, tarry stools; bleeding gums; blood in urine or stools; chest pain; chills; cough; convulsions; decreased urine or painful or difficult urination; difficult or labored breathing, shortness of breath or wheezing; dry mouth; fever; increased thirst; irregular heartbeat; loss of appetite; lower back or side pain; mood changes; muscle pain or cramps; nausea or vomiting; numbness or tingling in hands, feet or lips; pale skin; pinhead-sized red spots on skin; sore throat; sores, ulcers or white spots on lips or in mouth; swollen glands; tightness in chest; unusual bleeding or bruising; unusual tiredness or weakness.

<b>Leucovorin</b>	loo-koh-VOR-in
Wellcovorin®/folic acid	Antianemic
Given by intravenous (IV) or intramuscular (IM) injection, or taken by mouth	

Leucovorin is used to counteract some of the harmful effects of methotrexate given in high doses. It is also used to prevent or treat certain kinds of anemia. Leucovorin acts the same way in the body as folic acid, which may be low in patients with anemia.

**Side Effects Needing Medical Attention:** Allergic-like reactions; fatigue; weakness; nausea; vomiting; diarrhea; constipation; loss of appetite.

<b>Lomustine</b>	loe-MUS-teen
CeeNU®/CCNU	DNA-damaging agent
Taken by mouth	

Lomustine is used to treat some kinds of blood cancer.

**Side Effects Needing Medical Attention:** Fever, chills or sore throat; unusual bleeding or bruising; confusion; slurred speech; sores in mouth and on lips; swelling of feet or lower legs; unusual decrease in urination; unusual tiredness or weakness; yellowing of eyes and skin; cough or shortness of breath.

Read the General Information at the beginning of this chapter for important information that applies to this drug.



**Side Effects Needing Medical Attention After Stopping This Medication:**

Fever, chills or sore throat; unusual bleeding or bruising; loss of appetite; nausea and vomiting (usually lasts less than 24 hours); darkening of skin; rash and itching or pinhead-sized red spots on skin; black, tarry stools; blood in urine or stools; cough or hoarseness; lower back or side pain; painful or difficult urination.

<b>Mechlorethamine</b>	me-klor-ETH-a-meen	
Mustargen®/nitrogen mustard	DNA-damaging agent	
Given by intravenous (IV) injection		

Mechlorethamine is used to treat Hodgkin lymphoma and is sometimes prescribed for other uses.

**Side Effects Needing Medical Attention:** If mechlorethamine accidentally seeps out of the vein, it may damage some tissues and cause scarring. Your healthcare provider should be notified right away if you notice redness, pain or swelling at the IV site; wheezing; fever; chills; sore throat; missed menstrual periods; painful rash; unusual bleeding or bruising; dizziness; side and stomach pain; loss of hearing; ringing in ears; swelling of feet or lower legs; black, tarry stools; itching; numbness, tingling or burning of fingers, toes or face; shortness of breath; yellowing of eyes and skin.

**Side Effects Needing Medical Attention After Stopping This Medication:**

Fever; chills; sore throat; unusual bleeding or bruising.

<b>Melphalan</b>	MEL-fa-lan	
Alkeran®	DNA-damaging agent	
Taken by mouth or given by intravenous (IV) infusion		

Melphalan is used to treat certain myelomas, Waldenström macroglobulinemia and other blood cancers.

**Side Effects Needing Medical Attention:** Sudden rash and itching; difficulty breathing or shortness of breath; hives; black, tarry stools; fever, chills or sore throat; unusual bleeding or bruising; side or stomach pain; sores in mouth and on lips; cough; yellow discoloration of skin or eyes; missed menstrual period; swelling of feet or lower legs; nausea and vomiting; weight loss.

**Side Effects Needing Medical Attention After Stopping This Medication:**

Fever, chills or sore throat; unusual bleeding or bruising.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Mercaptopurine</b>	mer-kap-toe-PYOOOR-een
Purinethol®/6-MP	Antimetabolite
Taken by mouth	

Mercaptopurine is used to treat some types of blood cancers.

**Side Effects Needing Medical Attention:** Fever, chills or sore throat; unusual bleeding or bruising; unusual tiredness or weakness; yellowing of eyes and skin; loss of appetite; side or stomach pain; joint pain; nausea and vomiting; swelling of feet or lower legs; black, tarry stools; sores in mouth or on lips.

**Side Effects Needing Medical Attention After Stopping This Medication:** Fever, chills or sore throat; unusual bleeding or bruising; yellowing of eyes and skin.

<b>Methotrexate</b>	meth-o-TREX-ate
Rheumatrex®, Trexall®	Antimetabolite
Taken by mouth	

Methotrexate is used to treat cancers of the blood, bone and lymphatic system, including acute nonlymphocytic leukemia and Hodgkin lymphoma. It may also be used to treat other kinds of cancer.

**Side Effects Needing Medical Attention:** Black, tarry stools; bloody vomit; diarrhea; sores in mouth or on lips; stomach pain; fever; chills; sore throat; unusual bleeding or bruising; blood in urine or dark urine; blurred vision; confusion; convulsions or seizures; cough; dizziness; drowsiness; headache; joint pain; shortness of breath; rash; swelling of feet or lower legs; unusual tiredness or weakness; yellowing of eyes and skin; loss of appetite; nausea or vomiting. The above side effects may be more likely to occur in very young and very old patients.

**Side Effects Needing Medical Attention After Stopping This Medication:** Blurred vision; convulsions or seizures; dizziness; drowsiness; headache; confusion; unusual tiredness or weakness.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Mitomycin</b>	mye-toe-MYE-sin	
Mutamycin®	Antineoplastic	
Given by intravenous (IV) infusion		

Mitomycin is used to treat some kinds of cancer. This drug sometimes causes a temporary loss of hair. After treatment has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** If mitomycin accidentally seeps out of the vein, it may damage the skin and cause scarring. Your healthcare provider should be notified right away if you notice redness, pain or swelling at the IV site; blood in urine; difficulty breathing or shortness of breath; fever, chills or sore throat; unusual bleeding or bruising; cough; decreased urination; sores in mouth or on lips; swelling of feet or lower legs; bloody vomit; unusual tiredness or fatigue; blurred vision; loss of appetite; nausea and vomiting; drowsiness; headache.

**Side Effects Needing Medical Attention After Stopping This Medication:** Blood in urine; fever, chills or sore throat; unusual bleeding or bruising; decreased urination; shortness of breath; swelling of feet or lower legs; unusual tiredness or fatigue.

<b>Mitoxantrone</b>	my-toe-ZAN-trone	
Novantrone®	Antitumor antibiotic	
Given by intravenous (IV) infusion		

Mitoxantrone is used to treat some kinds of cancer. Mitoxantrone is a dark blue solution that may cause urine to appear blue-green. It may also cause the whites of the eyes to turn a blue color. These effects are normal and last for only 1 or 2 days after each dose is given. This medicine often causes a temporary loss of hair. After treatment with mitoxantrone has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** If mitoxantrone accidentally seeps out of the vein, it may severely damage some tissues and cause scarring. Your healthcare provider should be notified right away if you notice redness, pain or swelling at the IV site; fast or irregular heartbeat; rash or itching; fever or sore throat; unusual bleeding or bruising; mouth sores.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Nelarabine</b>	Nel-AY-re-been
Arranon®	Antimetabolite
Given by intravenous (IV) infusion	

Nelarabine is used to treat relapsed or refractory T-cell acute lymphoblastic leukemia and T-cell lymphoblastic lymphoma.

**Side Effects Needing Medical Attention:** Seizures; numbness and tingling in the hands, fingers, feet or toes; problems with fine motor skills such as buttoning clothes; unsteadiness while walking; increased tripping while walking; weakness when getting out of a chair or walking up stairs; fever; signs of infection; bruising easily or unusual bleeding; difficulty breathing; fatigue; paleness.

<b>Palifermin</b>	pal-ee-FER-min
Kepivance®	Antineoplastic adjunct, cytoprotective agent
Given by injection	

Palifermin is used to help prevent or lessen severe oral mucositis in patients receiving certain types of blood-cancer therapy.

**Side Effects Needing Medical Attention:** Check with your doctor immediately if you develop a rash.

<b>Pamidronate</b>	pam-ih-DRO-nate
Aredia®	Antihypercalcemic, bisphosphonate
Given by intravenous (IV) infusion	

Pamidronate is used to treat hypercalcemia (too much calcium in the blood), which may occur with some types of cancer.

**Side Effects Needing Medical Attention:** Fever; unusual tiredness or fatigue; difficulty breathing or shortness of breath; coughing; swelling; injection site reactions (redness or swelling); nausea; abdominal cramping; diarrhea; constipation; headache; loss of appetite; vomiting.

<b>Pegaspargase</b>	peg-AS-par-jase
Oncaspar®/PEG-L-asparaginase	Enzyme that prevents cancer cells from surviving
Given by intravenous (IV) infusion	

Pegaspargase is used to treat acute lymphocytic leukemia (ALL).

**Side Effects Needing Medical Attention:** Abdominal or stomach pain; blurry vision; constipation; dry mouth and skin; fatigue; increased hunger or thirst; increased need to urinate; nausea; rash; unexplained weight loss; vomiting.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Pentostatin</b>	pen-toe-STAT-in
Nipent®	Antimetabolite
Given by intravenous (IV) infusion	

Pentostatin is used to treat hairy cell leukemia and other blood cancers.

**Side Effects Needing Medical Attention:** Fever; chills; bone pain; weakness and fatigue; lack of coordination, especially in walking; skin disorders; unusual decrease or increase in urination; cough; inflammation of the eye; flulike symptoms; confusion; depression; dizziness; drowsiness; nausea and vomiting; decreased appetite; diarrhea; headache.

<b>Procarbazine</b>	pro-KAR-ba-zeen
Matulane®	DNA-damaging agent
Taken by mouth	

Procarbazine is used to treat some kinds of blood cancers. This medicine may cause a temporary loss of hair in some people. After treatment with procarbazine has ended, normal hair growth should return.

**Stop taking this medicine and check with the doctor immediately if the following side effects occur:** chest pains; rapid or irregular heartbeat; severe headache; stiff neck. These may be symptoms of a serious high blood pressure reaction that should have a doctor's attention.

**Other Side Effects Needing Medical Attention:** Hallucinations (seeing, hearing or feeling things that are not there); convulsions; unsteadiness; difficulty walking; confusion; headache; tingling or numbness in fingers or toes; fever; chills; sore throat; unusual bruising or bleeding; sores on mouth or lips; hives; rash; itching; unusual tiredness or fatigue; sleeplessness; stomach pain; yellow discoloration of skin or eyes; darkening of skin; bloody vomit; blurred or reduced vision; reduced hearing; increased urination; blood in urine; sweating; weakness; muscle or joint pain; swelling in legs or ankles; cough; dizziness or lightheadedness when getting up from a lying or sitting position; feeling of warmth or redness in face; nausea and vomiting; weight loss; constipation.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Rasburicase</b>	raz-BYOOR-i-case
Elitek®	Antineoplastic adjunct
Given by injection	

Rasburicase is used for the initial management of plasma uric acid levels in pediatric patients with leukemia, lymphoma and solid tumors who are receiving certain types of anticancer therapy expected to result in elevated plasma uric acid.

**Side Effects Needing Medical Attention:** Signs or symptoms of an allergic reaction (chest pain, dizziness, hives, rash, trouble breathing); cracked lips; diarrhea; difficulty in swallowing; sores, ulcers or white spots on lips, tongue or inside of mouth

<b>Rituximab</b>	rih-TUCKS-ih-mab
Rituxan®	Monoclonal antibody
Given by intravenous (IV) infusion	

Rituximab is a monoclonal antibody. It is used to treat non-Hodgkin lymphoma, chronic lymphocytic leukemia (CLL) and Waldenström macroglobulinemia.

**Side Effects Needing Medical Attention:** Fever; chills; difficulty breathing or shortness of breath; sensation of tongue or throat swelling; hives; itching; weakness; headache; nausea; vomiting; flushing; palpitations; chest pain; rash; dizziness; coughing; unusual tiredness or fatigue; unusual bruising or bleeding; muscle or joint pain; abdominal pain; diarrhea.

**Side Effects Needing Medical Attention After Stopping This Medication:** Black, tarry stools; blood in urine or stools; painful or difficult urination; pinhead-sized red spots on skin; unusual bleeding or bruising; unusual tiredness or weakness.

<b>6-Thioguanine</b>	six-thigh-oh-GWAN-noon
Tabloid®/thioguanine	Antimetabolite
Taken by mouth	

6-Thioguanine is used to treat some kinds of blood cancers.

**Side Effects Needing Medical Attention:** Fever; chills; sore throat; unusual bruising or bleeding; sores on mouth or lips; yellowing of skin or eyes; inability to eat; loose stools; stomach pain; rash; nausea and vomiting.

**Side Effects Needing Medical Attention After Stopping This Medication:** Black, tarry stools; blood in urine or stools; cough or hoarseness; fever or chills; lower back or side pain; painful or difficult urination; pinhead-sized red spots on skin; unusual bleeding or bruising.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Teniposide</b>	ten-IH-po-side
Vumon®/VM-26	Antineoplastic
Given by intravenous (IV) infusion	

Teniposide is used along with other medicines as induction therapy in patients with refractory childhood acute lymphoblastic leukemia, non-Hodgkin lymphoma and other types of cancer. This medicine often causes a temporary loss of hair. After treatment with teniposide has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Chills (severe); fever; hives; palpitations; difficulty breathing; dizziness; weakness; facial flushing; unusual tiredness or fatigue; unusual bruising or bleeding; rash; sores on mouth or lips; diarrhea; nausea; vomiting. It is important to tell your healthcare provider right away if redness, pain, swelling or a lump under the skin occurs in the area where the injection is given.

<b>Thalidomide</b>	tha-LI-doe-mide
Thalomid®	Immunomodulator, antiangiogen
Given by mouth	

Thalidomide is used to treat myeloma and myelodysplastic syndromes (MDS).

**Side Effects Needing Medical Attention:** Patients noticing peripheral neuropathy (tingling, burning, numbness or pain in the hands or feet) must stop taking the medication and call their doctor immediately. Also needing medical attention are muscle weakness; blood in urine; decreased urination; fever, alone or with chills and sore throat; irregular heartbeat; low blood pressure; rash; constipation; diarrhea; dizziness; drowsiness; nausea; stomach pain; dryness of mouth; dry skin; headache; increased appetite; mood changes; swelling in the legs.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Topotecan</b>	toe-poe-TEE-kan
Hycamtin®	DNA-repair enzyme inhibitor
Given by injection	

Topotecan is used to treat chronic myelomonocytic leukemia (CMML) and myelodysplastic syndrome (MDS) as well as other types of cancer. This drug may also cause a temporary loss of hair in some people. After treatment with topotecan has ended, normal hair growth should return.

**Side Effects Needing Medical Attention:** Black, tarry stools; blood in urine or stools; cough or hoarseness (accompanied by fever or chills); fever or chills; lower back or side pain (accompanied by fever or chills); painful or difficult urination (accompanied by fever or chills); pinhead-sized red spots on skin or rash, hives and/or itching; shortness of breath, troubled breathing or fast or irregular breathing; unusual bleeding or bruising; large, hivelike swellings on the face, eyelids, mouth, lips and/or tongue; puffiness or swelling of the eyelids or around the eyes; tightness in chest or wheezing; unusual tiredness or weakness; changes in the skin color of the face.

**Side Effects Needing Medical Attention After Stopping This Medication:** Abdominal or stomach pain; burning or tingling in hands or feet; constipation; diarrhea; fatigue; headache; loss of appetite; muscle weakness; nausea or vomiting; sores, ulcers or white spots on lips or tongue or inside the mouth.

<b>Tositumomab/I-131 Tositumomab</b>	toe-zee-TOO-moe-mab
Bexxar®	Radioimmunotherapeutic monoclonal antibody
Given intravenously (IV) once a week for 2 weeks	

Bexxar® (tositumomab and iodine I 131) is used for the treatment of patients with CD20-positive, low-grade, follicular non-Hodgkin lymphoma, or for patients with transformed (faster-growing) non-Hodgkin lymphoma. This drug is approved by the FDA for patients who have already received chemotherapy or Rituxan® (Rituximab), or a combination of both. This drug is for patients whose disease has not responded to therapy or has come back. It is given to patients only once. It is not known if it is safe to give to patients more than once, or to give together with other types of therapy.

**Side Effects Needing Medical Attention:** Weakness; infection; bleeding; fever; chills; nausea; cough; diarrhea; rash; swelling at the site of the injection; abdominal pain; dizziness.

Read the General Information at the beginning of this chapter for important information that applies to this drug.



<b>Tretinoin, ATRA</b>	TRET-i-noyn
Vesanoid®	Cell-maturing agent
Given by mouth	

Tretinoin is used for induction of remission in patients with acute promyelocytic leukemia (APL) who are refractory to or unable to tolerate anthracycline-based cytotoxic chemotherapeutic regimens.

**Side Effects Needing Medical Attention:** Difficulty in breathing or rapid breathing; wheezing; unexplained fever; weight gain or weight loss; dizziness; fainting; bone pain; discomfort or pain in chest or feeling of heaviness in chest; convulsions or seizures; difficulty speaking, slow speech or inability to speak; inability to move arms, legs or muscles of face; pain in back of left arm; unusual bleeding; blood in urine; cough; headache; joint pain; sores in mouth or on lips, or pain or sores in mouth or nose; changes in vision; coughing; sore throat; decreased urination; earache or feeling of fullness in ear; irregular heartbeat; depression or other mood, mental or personality changes; rash; swelling of abdomen, face, fingers, hands, feet or lower legs; cramping or pain in stomach (severe); difficult or painful urination; drowsiness (severe and continuing); pain in lower back or side; yellow eyes or skin; weakness and fatigue; nausea and vomiting; increased sweating; anxiety; confusion; constipation; diarrhea; dryness of skin, mouth or nose or cracked lips; feeling of burning, crawling or tingling in skin; flushing; general feeling of illness; indigestion; loss of appetite; shivering; trouble sleeping.

<b>Vinblastine</b>	Vin-BLAS-teen
Velban®	Drug that prevents cells from dividing by blocking mitosis (cell division)
Given by intravenous (IV) injection	

Vinblastine is used to treat certain kinds of cancer, including lymphoma.

**Side Effects Needing Medical Attention:** If vinblastine accidentally seeps out of the vein, it may damage the surrounding tissue and cause some scarring. Your healthcare provider should be notified right away if you notice redness, pain or swelling at the IV site; unusual tiredness or fatigue; fever; chills; sore throat; side or stomach pain; unusual bleeding or bruising; black, tarry stools; difficulty walking; dizziness; double vision; drooping eyelids; headache; jaw pain; depression; numbness or tingling in fingers and toes; pain in fingers and toes; pain in testicles; sores in mouth or on lips; weakness; muscle pain; nausea and vomiting.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

<b>Vincristine</b>	vin-KRIS-teen
Oncovin®	Drug that prevents cells from dividing by blocking mitosis (cell division)
Given by intravenous (IV) injection	

Vincristine is used to treat some types of blood cancer as well as some noncancerous conditions. Vincristine may cause hair loss in some patients. After treatment with vincristine has ended, or sometimes even during treatment, normal hair growth should return.

**Side Effects Needing Medical Attention:** If vincristine accidentally seeps out of the vein, it may damage some tissues and cause scarring. Your healthcare provider should be notified right away if redness, pain or swelling is noticed at the IV site. Other effects needing attention are difficulty breathing or shortness of breath; blurred or double vision; constipation; difficulty walking; drooping eyelids; side or stomach pain; headache; jaw pain; joint pain; numbness or tingling in fingers and toes; pain in fingers and toes; muscle pain; stomach cramps; bed-wetting; convulsions or seizures; dizziness or lightheadedness when getting up from a lying or sitting position; lack of sweating; loss of appetite; depression; painful or difficult urination; unconsciousness; unusual decrease or increase in urination; cough; fever, chills or sore throat; sores in mouth or on lips; unusual bleeding or bruising; bloating; diarrhea; weight loss; nausea and vomiting; rash.

<b>Vorinostat</b>	Vo-RIN-o-stat
Zolinza™	DNA transcription inhibitor
Given by mouth	

Vorinostat is a medicine used to treat cutaneous T-cell lymphoma (CTCL) in patients whose CTCL gets worse, does not go away or comes back after treatment with other medicines.

**Side Effects Needing Medical Attention:** Blood clots in the legs (deep vein thrombosis); sudden swelling in a leg; pain or tenderness in the leg (the pain may only be felt when standing or walking); increased warmth in the area where the swelling is; skin redness or change in skin color; sudden, sharp chest pain; rapid pulse; fainting; cough with bloody secretions; feeling anxious; sweating; dehydration (loss of too much fluid from the body); low red blood cells; unusual bleeding or bruising under the skin; high blood sugar; paleness, shortness of breath and unusual tiredness.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

LEUKEMIA

LYMPHOMA

MYELOMA

<b>Zoledronic Acid</b>	ZOE-le-dron-ik acid
Zometa®	Antihypercalcemic, bisphosphonate
Given by intravenous (IV) injection	

Zoledronic acid is used to treat hypercalcemia (high levels of blood calcium) that may occur in patients with some types of cancer, including myeloma.

**Side Effects Needing Medical Attention:** Black, sticky stools; chest pain; convulsions; irregular heartbeat; lack or loss of strength; lower back or side pain; mood or mental changes; confusion; muscle pain or cramps; muscle trembling or twitching; shaking of hands, arms, feet, legs or face; nausea or vomiting; numbness and tingling around mouth, fingertips or feet; painful or difficult urination; pale skin; shortness of breath or wheezing; difficult or labored breathing; trouble breathing with exercise; rash; cracks in skin at the corners of mouth; soreness or redness around fingernails and toenails; tightness in chest; unusual bleeding or bruising; unusual tiredness or weakness; abdominal pain; bone pain; constipation; dehydration; diarrhea; difficulty swallowing; fever; headache; loss of appetite; pain, swelling or redness in joints; sleepiness or unusual drowsiness; trouble sleeping; swelling of leg; weight loss; white spots on lips, tongue or inside of mouth.

Read the General Information at the beginning of this chapter for important information that applies to this drug.

## Drug Therapy Combinations

The use of cancer agents in combination is common in the treatment of leukemia, Hodgkin and non-Hodgkin lymphomas, and myeloma. Giving different medications together may result in more effective treatment. The chart below lists some of the common combinations in chemotherapy. The chart is intended to serve only as a general guide, since variations of many of the combinations exist. Refer to the section on each drug for information on each medicine.

**Table 4: Some Common Drug Therapy Combinations**

<b>Leukemias</b>	
AA	cytarabine + doxorubicin
AVDP	asparaginase + vincristine + daunorubicin + prednisone
CD	cytarabine + daunorubicin
COAP	cyclophosphamide + vincristine + cytarabine + prednisone
CVP	cyclophosphamide + vincristine + prednisone
DCT	daunorubicin + cytarabine + thioguanine
DVP	daunorubicin + vincristine + prednisone
MC	mitoxantrone + cytarabine
MM	mercaptopurine + methotrexate
MV	mitoxantrone + etoposide
TC	thioguanine + cytarabine
<b>Hodgkin Lymphoma</b>	
ABVD	doxorubicin + bleomycin + vinblastine + dacarbazine
B-CAVe	bleomycin + lomustine + doxorubicin + vinblastine
B-DOPA	bleomycin + dacarbazine + vincristine + prednisone + doxorubicin

**Table 4: Some Common Drug Therapy Combinations (cont'd.)**

CVPP	cyclophosphamide + vinblastine + procarbazine + prednisone
MOPP	mechlorethamine + vincristine + procarbazine + prednisone
MVPP	mechlorethamine + vinblastine + procarbazine + prednisone
<b>Non-Hodgkin Lymphoma</b>	
BACOP	bleomycin + doxorubicin + cyclophosphamide + vincristine + prednisone
CHOP	cyclophosphamide + doxorubicin + vincristine + prednisone
CHOP-Bleo	cyclophosphamide + doxorubicin + vincristine + prednisone + bleomycin
COMLA	cyclophosphamide + vincristine + methotrexate + cytarabine
COP	cyclophosphamide + vincristine + prednisone
COPP	cyclophosphamide + vincristine + procarbazine + prednisone
CYP	cyclophosphamide + vincristine + prednisone
EPOCH	etoposide + prednisone + vincristine + cyclophosphamide + adriamycin
ESHAP	etoposide + cisplatin + methylprednisone + cytarabine
ICE	ifosfamide + carboplatin + etoposide
IMVP-16	ifosfamide + methotrexate + etoposide
MBACOP	methotrexate + bleomycin + doxorubicin + cyclophosphamide + vincristine + dexamethasone

**Table 4: Some Common Drug Therapy Combinations (cont'd.)**

MINE	ifosfamide + mitoxantrone + etoposide
ProMACE	prednisone + methotrexate + doxorubicin + cyclophosphamide + etoposide
RICE	Rituxan® + ifosfamide + carboplatin + etoposide
<b>Myeloma</b>	
AC	doxorubicin + carmustine
BCP	carmustine + cyclophosphamide + prednisone
MeCP	methyl-CCNU + cyclophosphamide + prednisone
MP	melfhalan + prednisone
MPR	melfhalan + prednisone + Revlimid®
MPV	melfhalan + prednisone + Velcade®
M-2	vincristine + carmustine + cyclophosphamide + melfhalan + prednisone
VAD	vincristine + doxorubicin + dexamethasone
VBAP	vincristine + carmustine + doxorubicin + prednisone
RD	Revlimid® + dexamethasone
VD	Velcade® + dexamethasone
VR	Velcade® + Revlimid®

# Glossary

## **Absolute neutrophil count**

The real number of white blood cells that are neutrophils. The absolute neutrophil count is commonly called the ANC.

## **Anticoagulant therapy**

Agents used to block blood clotting when abnormal blood clotting is occurring or is at risk of occurring. Heparin may be used because of its immediate action. It must be injected and if long-term treatment is required, is often replaced later by another anticoagulant, warfarin, which can be taken by mouth in pill form.

## **Blood count**

A laboratory test requiring a small blood sample that is used to measure the number and types of cells circulating in the blood. The term “complete blood count,” or CBC, is often used to refer to this test.

## **Central nervous system (CNS)**

The brain and the spinal cord. This term distinguishes these portions of the nervous system from the vast network of peripheral nerves that emerge from the brain and spinal cord.

## **Chemotherapy**

The use of chemicals (drugs or medications) to kill malignant cells. Numerous chemicals have been developed for this purpose, and most act to injure the DNA of the cells. When the DNA is injured, the cells cannot grow or survive. Successful chemotherapy depends on the fact that cancer cells are somewhat more sensitive to the chemicals than normal cells. Because the normal cells of the marrow, the intestinal tract, the skin and the hair follicles are most sensitive to these chemicals, effects on these organs cause the most common side effects of chemotherapy; that is, low blood-cell counts, mouth sores, diarrhea and hair loss.

## **Cytokines**

These are cell (“cyto”)-derived chemicals secreted by various types of cells; they act on other cells to stimulate or inhibit their function. Chemicals derived from lymphocytes are called “lymphokines.” Chemicals derived from lymphocytes that act on other white blood cells are called “interleukins”; that is, they interact between two types of leukocytes. Some cytokines can be made commercially and used in treatment. Granulocyte colony-stimulating factor (G-CSF) is one such cytokine. It stimulates the production of neutrophils and shortens the period of low neutrophil counts in the blood after chemotherapy. Cytokines that stimulate cell growth are sometimes referred to as “growth factors.”

**DNA**

Short for deoxyribonucleic acid. It is the chemical building block in the cell containing the information that determines the characteristics of most living organisms.

**Dysphagia**

Difficulty in swallowing. It is often accompanied by a feeling of discomfort as food passes from the esophagus to the stomach.

**Emesis**

The medical term for vomiting.

**Esophagus**

Part of the body's digestive system, it is the tube that leads from the mouth to the stomach.

**Graft versus host disease (GVHD)**

The immune attack by a donor's lymphocytes against the tissues of the recipient (the host). The immune cells most engaged in this reaction are donor T lymphocytes, which are present in the donor's blood or marrow, the source of stem cells (the graft). The principal sites of injury are the skin, the liver and the gastrointestinal tract. The reaction may be minimal in closely matched individuals or severe in less well-matched individuals. The reaction does not occur in transplants between identical twins.

**Hematocrit**

The proportion of the blood occupied by red cells. Normal values are 40%-54% in males, 35%-47% in females. When the hematocrit is below normal, one has anemia. When the hematocrit is above normal, one has erythrocytosis.

**Hemoglobin**

The iron-containing pigment in red cells that carries oxygen to the tissue cells. A reduction in red cells decreases hemoglobin concentration in the blood, resulting in the condition called "anemia." The decrease in hemoglobin concentration lessens the oxygen-carrying ability of blood. If severe, this may limit a person's energy. Normal values of blood hemoglobin are 12 to 18 grams per 100 milliliters of blood. Healthy women have on average about 10 percent less hemoglobin in their blood than men do.

**Hemorrhage**

Excessive or unchecked bleeding either internally or to the outside of the body.

**Immune system**

The body system responsible for protecting the individual from invasion of foreign agents, especially microorganisms such as bacteria, viruses, fungi and other parasites. The immune system is made up of the cells and tissues involved in this process, such as the various types of lymphocytes and the lymph nodes.



## **Immunosuppression**

A state in which the immune system does not function properly and its protective functions are inadequate. Immunosuppressed individuals are more susceptible to infections, including those from microbes that are usually not highly infectious. This state can be caused by intensive chemotherapy and radiation therapy, especially as used for conditioning of a patient for transplantation. It can also occur as a result of disease. Human immunodeficiency virus (HIV) infection can lead to immunosuppression. Graft versus host disease (GVHD) creates an immunosuppressive state. In the transplant patient, the conditioning regimen and severe GVHD can combine to permit overwhelming infection.

## **Intrathecal**

Within the spinal canal, the space between the covering or lining of the brain and spinal cord. The lining is called the “meninges.” In some situations drugs have to be administered into the spinal canal when leukemia or lymphoma cells are on the meninges. This process is called intrathecal therapy.

## **Intravenous infusion**

The administration of antibiotics, blood products, anticancer drugs or nutrient fluids into a patient’s vein over a period of time.

## **Leukemia**

Leukemia is a cancer of the marrow and blood. The disease appears in four major forms. Each major form has several subtypes. Acute lymphocytic leukemia (ALL) and acute myelogenous leukemia (AML) are characterized by the uncontrolled accumulation of abnormal cells, referred to as “leukemic blasts.” These cells fill the marrow and enter the blood. Chronic myelogenous leukemia (CML) and chronic lymphocytic leukemia (CLL) progress less rapidly than the acute leukemias. However, CML requires treatment at the time of diagnosis; certain subtypes of CLL may be nonprogressive for long periods.

## **Lumbar puncture**

A procedure to remove spinal fluid from the space surrounding the spinal cord or to administer anticancer drugs to either prevent or treat leukemia or lymphoma of the coverings of the central nervous system. The physician will first use a local anesthetic, then insert a needle between two vertebrae in the lower part of the back. Fluid samples are collected in sterile tubes and examined for evidence of leukemia or lymphoma. This procedure is also called a “spinal tap.”

## **Lymph nodes**

Small structures the size of beans that contain large numbers of lymphocytes and are connected with each other by small channels called “lymphatics.” These nodes are distributed throughout the body. In patients with lymphoma and some types of lymphocytic leukemia, the malignant lymphocytes grow and expand the lymph nodes, so they may be enlarged. This enlargement of lymph nodes can be seen, felt or measured by computed tomography (CT) scan or magnetic resonance imaging (MRI), depending on the degree of enlargement and location.

**Lymphocyte**

A type of white cell that is essential to the body's immune system. There are three major types of lymphocytes: B lymphocytes, which produce antibodies to help combat infectious agents like bacteria, viruses and fungi; T lymphocytes, which have several functions, including assisting B lymphocytes in making antibodies; and natural killer (NK) cells, which can attack virus-infected cells or tumor cells.

**Lymphoma**

A cancer that starts in a lymphocyte, usually in a lymph node, but may start in a lymphocyte in the lymphatic tissue of the marrow, gastrointestinal tract, spleen, skin or other sites. The disease results from the uncontrolled accumulation of malignant lymphocytes.

**Marrow**

A spongy tissue that occupies the hollow central cavity of bones and is the site of blood-cell formation. By puberty, the marrow in the spine, ribs, breastbone, hips, shoulders and skull is most active in blood-cell formation. In the adult, the bones of the hands, feet, legs and arms do not contain marrow in which blood cells are made. In these sites, the marrow is filled with fat cells. When marrow cells have matured into blood cells, they enter the blood that passes through the marrow and are carried throughout the body.

**Marrow depression**

The decrease in blood-cell production in the marrow that may occur after chemotherapy or radiotherapy if the latter involves large areas of marrow-containing bones.

**Mucositis**

A complication of some cancer therapies in which the lining of the digestive system becomes inflamed. Mucositis can occur anywhere along the digestive tract from the mouth to the anus. Often seen as sores in the mouth.

**Mucous membranes (Mucosa)**

The lining of tubular structures such as the inner lining of the mouth, nose, sinuses, esophagus, vagina and many others. These linings require new cells to be made to replace those that drop off. This replacement is a normal process and keeps the lining intact and moist. In patients receiving radiation or cytotoxic drugs that block cells from dividing, the replacement of lost cells is prevented and the linings become dry and defective and may ulcerate. This change can be painful, such as when mouth ulcers develop. The loss of what is referred to as the "barrier function" of mucous membranes permits microbes to enter the tissue or blood, which may lead to infection.

**Myeloma**

A cancer of plasma cells (derived from B lymphocytes) that begins in the bone marrow. The cells secrete chemicals that stimulate the overactivity of bone-dissolving cells, called osteoclasts, leading to osteoporosis and brittle bones that fracture easily. A form of myeloma involving multiple marrow sites is the most common type of the disease. Some cases of myeloma progress very slowly. They may be referred to as smoldering or indolent myeloma.

**Nadir**

The lowest point. It is the opposite of zenith, or highest point. In medicine, nadir is used to refer to the lowest blood cell counts after cytotoxic therapy. For example, a nadir of 20,000 platelets per microliter of blood represents the lowest platelet count reached after therapy. The term implies that the blood-cell counts will rise after that time. The time at which the nadir of blood-cell counts occurs may be predictable in approximate terms based on previous experience with the drugs and dosages used. Thus, a treating physician may anticipate the lowest blood count time following chemotherapy and institute special care to observe possible ill effects. The nadirs for white cell, platelet and red cell counts often occur at different times.

**Neutropenia**

A decrease below normal in the concentration of neutrophils, a type of white cell.

**Ommaya reservoir**

A device inserted under the scalp with a tube leading into the fluid channel that bathes the brain. It is used to inject drugs into that fluid. The technique is used for patients with leukemia or lymphoma that involves the covering of the brain so as to get adequate concentrations of the drug to that site.

**Petechiae**

Pinhead-sized sites of bleeding in the skin. This type of bleeding results from a very low platelet count. The tiny hemorrhages are frequently seen on the legs, feet, trunk and arms. They evolve from red to brown and eventually disappear. They stop developing when the platelet count increases.

**Pharyngitis**

The medical term for an inflamed or sore throat. Strep throat is technically a streptococcal pharyngitis. Pharyngitis is usually caused by a bacterial or viral infection.

**Platelets**

Small blood cells (about one-tenth the volume of red cells) that stick to the site of blood vessel injury, aggregate with each other and seal off the injured blood vessel to stop bleeding. "Thrombocyte" is a synonym for platelet and is often used as the prefix in terms describing disorders of platelets, such as thrombocytopenia or thrombocythemia.

**Radiotherapy**

The use of x-rays and other forms of radiation in treatment. Radiotherapy is useful in the treatment of localized lymphomas, especially Hodgkin lymphoma, central nervous system lymphoblastic leukemia and localized myeloma.

**Red cells**

Blood cells that contain hemoglobin. When red cells pass through the lungs, hemoglobin binds oxygen and then releases it to the tissues of the body. The red cells make up a little less than half the volume of blood in healthy individuals.

**Remission**

A disappearance of evidence of a disease, usually as a result of treatment. The terms “complete” or “partial” are used to modify the term “remission.” Complete remission means all evidence of a disease is gone. Partial remission means the disease is markedly improved by treatment, but residual evidence of the disease is present. Long-term benefit usually requires a complete remission, especially in acute leukemia or progressive lymphomas.

**RNA**

Short for ribonucleic acid, a chemical found in the nucleus and cytoplasm of cells. RNA plays an important role in making protein and in other chemical activities of the cell.

**Subcutaneous injection**

An injection into tissue immediately under the skin.

**Thrombocytopenia**

A decrease below normal in the concentration of the blood platelets.

**Thrush**

A fungal infection of the mouth, tongue or throat. A specific fungus referred to as Candida or oral candidiasis is the cause. It is usually manifest by white patches of fungal colonies on the surface of the oral tissues and may be painful.

**Toxicity**

The degree of side effects from administration of drugs or radiation therapy. Drug toxicity may range from mild and tolerable to life-threatening. Toxicity may also be transient or longstanding. Since most therapy that is directed at injuring and killing cells is nonspecific, normal tissues are often affected along with cancer cells.

**White cells**

A synonym for “leukocytes.” There are five major types of white cells in the blood: neutrophils, eosinophils, basophils, monocytes and lymphocytes.

# Resources

## **The Leukemia & Lymphoma Society Publications**

*Acute Lymphocytic Leukemia*; 2005.

*Acute Myelogenous Leukemia*; 2006.

*Chronic Lymphocytic Leukemia*; 2005.

*Chronic Myelogenous Leukemia*; 2006.

*The Lymphomas*; 2006.

*Myeloma*; 2006.

*Blood and Marrow Stem Cell Transplantation*; 2005.

*Blood Transfusion*; 2006.

*Fatigue fact sheet*; 2004.

*Immunotherapy fact sheet*; 2004.

*Integrative Medicine & Complementary and Alternative Therapies as Part of Blood Cancer Care fact sheet*; 2006.

*Long-Term and Late Effects of Treatment for Blood Cancers fact sheet*; 2004.

*Understanding Blood Counts fact sheet*; 2003.

*Understanding Clinical Trials for Blood Cancers*; 2006.

*Vaccine Therapy Facts*; 2006.

## **Nontechnical Resources**

*Educating a Child with Cancer: A Guide for Parents and Teachers.* Keene N, ed. Candlelighters; 2003.

*Adult Leukemia: A Comprehensive Guide for Patients and Families.* Lacklitz B. O'Reilly & Associates; 2001.

*Informed Decisions.* Eyre HJ, Lange DP, Morris LB. American Cancer Society; 2002.

The National Cancer Institute's booklet *Eating Hints for Cancer Patients: Before, During & After Treatment* provides tips about how to make eating easier and more enjoyable. It also gives many ideas about how to eat well and get extra protein and calories during cancer treatment. For a free copy of this booklet, ask your nurse or call the Cancer Information Service at (800) 4-CANCER [(800) 422-6237].

## **Technical Sources**

*Oncology Nursing Drug Handbook.* Wilkes GM, Ingwersen K, Barton-Burke M. Jones and Bartlett Publishers; 2006.

*Physicians' Cancer Chemotherapy Drug Manual 2006.* Chu E, DeVita VT. Jones & Bartlett Publishers; 2006.

*Micromedex® Healthcare Series.* Greenwood Village, Colo: Thomson Micromedex. Available at: [www.micromedex.com](http://www.micromedex.com) (Internet database)]. Updated periodically.

# Drug Therapy Index

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# Call Our Information Resource Center

The Society's Information Resource Center (IRC) provides patients, families and healthcare professionals with the latest information on leukemia, lymphoma and myeloma. Our information specialists – master's level oncology professionals – are available by phone (800.955.4572) Monday through Friday, 9 am to 6 pm (ET); via email ([infocenter@LLS.org](mailto:infocenter@LLS.org)); or chat online at [www.LLS.org](http://www.LLS.org) (click on "Live Help").

Call 800.955.4572 for a complete directory of our patient services programs.



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