

Cytarabine (Cytosar-U®, Ara-C, DepoCyt®)

Pronounce: SITE-ah-rah-been

Classification: Antimetabolite

About Cytarabine (Cytosar-U®, Ara-C, DepoCyt®)

Cytarabine affects the DNA of cells. How it works is not clearly understood, but it seems to affect DNA polymerase (an important enzyme in DNA synthesis). Because cells cannot copy their DNA, they cannot properly divide, causing the cancer cells to die.

How to Take Cytarabine

Cytarabine is given through intravenous (into a vein) infusion or subcutaneous (SQ, under the skin) injection. This medication can also be given directly into the spinal column (intrathecal) to treat or prevent cancer or metastasis. The side effects experienced as a result of intrathecal treatment may be different. The dosage and schedule is determined by the person's size, type of cancer, and mode of administration. It can be given alone or with other drugs.

Possible Side Effects

There are a number of things you can do to manage the side effects of cytarabine. Talk to your care team about these recommendations. They can help you decide what will work best for you. These are some of the most common or important side effects:

Low White Blood Cell Count (Leukopenia or Neutropenia)

White blood cells (WBC) are important for fighting infection. While receiving treatment, your [WBC count can drop](#), putting you at a higher risk of getting an infection. You should let your doctor or nurse know right away if you have a fever (temperature greater than 100.4°F or 38°C), sore throat or cold, shortness of breath, cough, burning with urination, or a sore that doesn't heal.

Tips to preventing infection:

- [Washing hands](#), both yours and your visitors, is the best way to prevent the spread of infection.
- Avoid large crowds and people who are sick (i.e.: those who have a cold, fever or cough or live with someone with these symptoms).
- When working in your yard, wear protective clothing including long pants and gloves.
- Do not handle pet waste.
- Keep all cuts or scratches clean.
- Shower or bathe daily and perform frequent [mouth care](#).
- Do not cut cuticles or ingrown nails. You may wear nail polish, but not fake nails.
- Ask your oncology care team before scheduling dental appointments or procedures.
- Ask your oncology care team before you, or someone you live with, has any vaccinations.

Low Red Blood Cell Count (Anemia)

Your red blood cells are responsible for carrying oxygen to the tissues in your body. When the [red cell count is low](#), you may feel tired or weak. You should let your oncology care team know if you experience any shortness of breath, difficulty breathing or pain in your chest. If the count gets too low, you may receive a blood transfusion.

Low Platelet Count (Thrombocytopenia)

Platelets help your blood clot, so when the [count is low](#) you are at a higher risk of bleeding. Let your oncology care team know if you have any excess bruising or bleeding, including nose bleeds, bleeding gums or blood in your urine or stool. If the platelet count becomes too low, you may receive a transfusion of platelets.

- Do not use a razor (an electric razor is fine).
- Avoid contact sports and activities that can result in injury or bleeding.
- Do not take aspirin (salicylic acid), non-steroidal, anti-inflammatory medications (NSAIDs) such as Motrin/Advil (ibuprofen), Aleve (naproxen), Celebrex (celecoxib) etc. as these can all increase the risk of bleeding. Please consult with your healthcare team regarding use of these agents and all over the counter medications/supplements while on therapy.
- Do not floss or use toothpicks and use a soft-bristle toothbrush to brush your teeth.

Nausea and/or Vomiting

Talk to your oncology care team so they can prescribe medications to help you manage [nausea and vomiting](#). In addition, dietary changes may help. Avoid things that may worsen the symptoms, such as heavy or greasy/fatty, spicy or acidic foods (lemons, tomatoes, oranges). Try saltines, or ginger ale to lessen symptoms.

Call your oncology care team if you are unable to keep fluids down for more than 12 hours or if you feel lightheaded or dizzy at any time.

Mouth Ulcers (Mucositis)

Certain cancer treatments can cause [sores or soreness in your mouth](#) and/or throat. Notify your oncology care team if your mouth, tongue, inside of your cheek or throat becomes white, ulcerated or painful. Performing [regular mouth care](#) can help prevent or manage mouth sores. If mouth sores become painful, your doctor or nurse can recommend a pain reliever.

- Brush with a soft-bristle toothbrush or cotton swab twice a day.
- Avoid mouthwashes that contain alcohol. A baking soda and/or salt with warm water mouth rinse (2 level teaspoons of baking soda or 1 level teaspoon of salt in an eight ounce glass of warm water) is recommended 4 times daily.
- If your mouth becomes dry, eat moist foods, drink plenty of fluids (6-8 glasses), and suck on sugarless hard candy.
- Avoid smoking and chewing tobacco, drinking alcoholic beverages, and citrus juices.

Loss or Thinning of Scalp and Body Hair (Alopecia)

Your hair may become [thin, brittle, or may fall out](#). This typically begins two to three weeks after treatment starts. This hair loss can be all body hair, including pubic, underarm, legs/arms, eyelashes, and nose hairs. The use of scarves, wigs, hats, and hairpieces may help. Hair generally starts to regrow soon after treatment is completed. Remember your hair helps keep you warm in cold weather, so a hat is particularly important in cold weather or to protect you from the sun.

Decrease in Appetite or Taste Changes

[Nutrition](#) is an important part of your care. Cancer treatment can affect your appetite and, in some cases, the side effects of treatment can make eating difficult. Ask your oncology care team about nutritional counseling services at your treatment center to help with food choices.

- Try to eat five or six small meals or snacks throughout the day, instead of 3 larger meals.
- If you are not eating enough, nutritional supplements may help.
- You may experience a metallic taste or find that food has no taste at all. You may dislike foods or beverages that you liked before receiving cancer treatment. These symptoms can last for several months or longer after treatment ends.
- Avoid any food that you think smells or tastes bad. If red meat is a problem, eat chicken, turkey, eggs, dairy products and fish without a strong smell. Sometimes cold food has less of an odor.
- Add extra flavor to meat or fish by marinating it in sweet juices, sweet and sour sauce or dressings. Use seasonings like basil, oregano or rosemary to add flavor. Bacon, ham and onion can add flavor to vegetables.

Diarrhea

Your oncology care team can recommend medications to relieve [diarrhea](#). Also, try eating [low-fiber](#), bland foods, such as white rice and boiled or baked chicken. Avoid raw fruits, vegetables, whole grain breads, cereals and seeds. Soluble fiber is found in some foods and absorbs fluid, which can help relieve diarrhea. Foods high in soluble fiber include: applesauce, bananas (ripe), canned fruit, orange sections, boiled potatoes, white rice, products made with white flour, oatmeal, cream of rice, cream of wheat, and farina. Drink 8-10 glasses of non-alcoholic, un-caffeinated fluid a day to prevent dehydration.

Hand Foot Syndrome

[Hand foot syndrome](#) (HFS) is a skin reaction that appears on the palms of the hands and/or the soles of the feet, as a result of certain chemotherapy agents being absorbed by the skin cells. HFS can begin as a mild tingling, numbness, pins-and-needles feeling, redness or pain or swelling of the hands and/or feet. This can then progress to painful swelling, blistering or peeling skin that can interfere with your ability to do normal activities. Be sure to let your oncology team know right away if you notice these symptoms, as they may need to adjust the chemotherapy dose or take a break to allow the skin to heal. Some tips to help prevent HFS include:

- Keep hands and feet clean and dry.
- Avoid tight shoes or socks.
- Avoid activities that put pressure on the palms or soles for 1 week after treatment.
- Apply an alcohol-free moisturizer liberally and often. (Avoid moisturizers with perfumes or scents)
- Avoid very hot water for baths and showers.

Liver Toxicity

This medication can cause liver toxicity, which your doctor may monitor for using blood tests called liver function tests. Notify your healthcare provider if you notice yellowing of the skin or eyes, your urine appears dark or brown or pain in your abdomen, as these can be signs of liver toxicity.

Tumor Lysis Syndrome

If there are a large amount of tumor cells in your body prior to treatment, you are at risk for tumor lysis syndrome. This happens when the tumor cells die too quickly and their waste overwhelms the body. You may be given a medication (allopurinol) and IV fluids to help prevent this. If you experience nausea, vomiting, diarrhea or become lethargic (drowsy, sluggish), notify your oncology team right away. TLS can affect your kidney function. Your provider will monitor your kidney function with blood work. Notify your provider if you have little or no urine output.

Fatigue

[Fatigue](#) is very common during cancer treatment and is an overwhelming feeling of exhaustion that is not usually relieved by rest. While on cancer treatment, and for a period after, you may need to adjust your

schedule to manage fatigue. Plan times to rest during the day and conserve energy for more important activities. Exercise can help combat fatigue; a simple daily walk with a friend can help. Talk to your healthcare team for helpful tips on dealing with this side effect.

Live Vaccines

You, or anyone you live with, should avoid having live or live-attenuated vaccines while receiving this medication. These include herpes zoster (Zostavax) for shingles prevention, oral polio, measles, nasal flu vaccine (FluMist®), rotavirus and yellow fever vaccines.

Side Effects with High-Dose Regimens

High dose regimens are often used in the treatment of leukemia and this regimen is associated with specific side effects:

- **Neurologic Toxicity:** This can include changes in personality, sedation, difficulty with walking, balance, and coordination. Your nurse will perform neurologic checks prior to each dose to detect these side effects.
- **Eye Changes:** This most often causes a type of conjunctivitis. You may be given a steroid eye drop several times a day to prevent this side effect.

Reproductive Concerns

Exposure of an unborn child to this medication could cause birth defects, so you should not become pregnant or father a child while on this medication. Effective birth control is necessary during treatment and after treatment. Even if your menstrual cycle stops or you believe you are not producing sperm, you could still be fertile and conceive. You should consult with your healthcare team before breastfeeding while receiving this medication.

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

Pronounce: e-toe-POE-side

Classification: Topoisomerase inhibitor

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

Etoposide works by blocking the action of an enzyme in cells called topoisomerase, which is necessary for cell replication and tumor growth. Cells need this enzyme to keep their DNA in the proper shape when they are dividing. Blocking this enzyme leads to breaks in the DNA, which leads to cancer cell death.

How to Take Etoposide

Etoposide is given by intravenous (IV, into a vein) infusion. It can also be given by mouth in the form of a [capsule](#), but this article will focus on the intravenous route. The dosage and schedule is determined by the person's size, type of cancer, and mode of administration. It can be given alone or with other medications.

Even when carefully and correctly administered by trained personnel, this drug may cause a feeling of burning and pain. There is a risk that this medication may leak out of the vein at the injection site, resulting in tissue damage that can be severe. If the area of injection becomes red, swollen, or painful at any time during or after the injection, notify your care team immediately. Do not apply anything to the site unless instructed by your care team.

Possible Side Effects of Etoposide

There are a number of things you can do to manage the side effects of etoposide. Talk to your care team about

these recommendations. They can help you decide what will work best for you. These are some of the most common or important side effects:

Low White Blood Cell Count (Leukopenia or Neutropenia)

White blood cells (WBC) are important for fighting infection. While receiving treatment, your [WBC count can drop](#), putting you at a higher risk of getting an infection. You should let your doctor or nurse know right away if you have a fever (temperature greater than 100.4°F or 38°C), sore throat or cold, shortness of breath, cough, burning with urination, or a sore that doesn't heal.

Tips to preventing infection:

- [Washing hands](#), both yours and your visitors, is the best way to prevent the spread of infection.
- Avoid large crowds and people who are sick (i.e.: those who have a cold, fever or cough or live with someone with these symptoms).
- When working in your yard, wear protective clothing including long pants and gloves.
- Do not handle pet waste.
- Keep all cuts or scratches clean.
- Shower or bathe daily and perform frequent [mouth care](#).
- Do not cut cuticles or ingrown nails. You may wear nail polish, but not fake nails.
- Ask your oncology care team before scheduling dental appointments or procedures.
- Ask your oncology care team before you, or someone you live with has any vaccinations.

Low Red Blood Cell Count (Anemia)

Your red blood cells are responsible for carrying oxygen to the tissues in your body. When the [red cell count is low](#), you may feel tired or weak. You should let your oncology care team know if you experience any shortness of breath, difficulty breathing, or pain in your chest. If the count gets too low, you may receive a blood transfusion.

Low Platelet Count (Thrombocytopenia)

Platelets help your blood clot, so when the [count is low](#) you are at a higher risk of bleeding. Let your oncology care team know if you have any excess bruising or bleeding, including nose bleeds, bleeding gums or blood in your urine or stool. If the platelet count becomes too low, you may receive a transfusion of platelets.

- Do not use a razor (an electric razor is fine).
- Avoid contact sports and activities that can result in injury or bleeding.
- Do not take aspirin (salicylic acid), non-steroidal, anti-inflammatory medications (NSAIDs) such as Motrin/Advil (ibuprofen), Aleve (naproxen), Celebrex (celecoxib) etc. as these can all increase the risk of bleeding. Please consult with your healthcare team regarding use of these agents and all over the counter medications/supplements while on therapy.
- Do not floss or use toothpicks and use a soft-bristle toothbrush to brush your teeth.

Mouth Ulcers (Mucositis)

Certain cancer treatments can cause [sores or soreness in your mouth](#) and/or throat. Notify your oncology care team if your mouth, tongue, inside of your cheek, or throat becomes white, ulcerated, or painful. Performing [regular mouth care](#) can help prevent or manage mouth sores. If mouth sores become painful, your doctor or nurse can recommend a pain reliever.

- Brush with a soft-bristle toothbrush or cotton swab twice a day.
- Avoid mouthwashes that contain alcohol. A baking soda and/or salt with warm water mouth rinse (2

level teaspoons of baking soda or 1 level teaspoon of salt in an eight ounce glass of warm water) is recommended 4 times daily.

- If your mouth becomes dry, eat moist foods, drink plenty of fluids (6-8 glasses), and suck on sugarless hard candy.
- Avoid smoking and chewing tobacco, drinking alcoholic beverages and citrus juices.

Nausea and/or Vomiting

Talk to your oncology care team so they can prescribe medications to help you manage [nausea and vomiting](#). In addition, dietary changes may help. Avoid things that may worsen the symptoms, such as heavy or greasy/fatty, spicy or acidic foods (lemons, tomatoes, oranges). Try saltines, or ginger ale to lessen symptoms.

Call your oncology care team if you are unable to keep fluids down for more than 12 hours or if you feel lightheaded or dizzy at any time.

Loss or Thinning of Scalp and Body Hair (Alopecia)

Your hair may become [thin, brittle, or may fall out](#). This typically begins two to three weeks after treatment starts. This hair loss can be all body hair, including pubic, underarm, legs/arms, eyelashes, and nose hairs. The use of scarves, wigs, hats, and hairpieces may help. Hair generally starts to regrow soon after treatment is completed. Remember your hair helps keep you warm in cold weather, so a hat is particularly important in cold weather or to protect you from the sun.

Fatigue

[Fatigue](#) is very common during cancer treatment and is an overwhelming feeling of exhaustion that is not usually relieved by rest. While on cancer treatment, and for a period after, you may need to adjust your schedule to manage fatigue. Plan times to rest during the day and conserve energy for more important activities. Exercise can help combat fatigue; a simple daily walk with a friend can help. Talk to your healthcare team for helpful tips on dealing with this side effect.

Less common, but important side effects can include:

- **Lowering of Blood Pressure:** Blood pressure may drop while this medication is being infused. When receiving this medication through a vein, your nurse will be checking your blood pressure before and during the infusion. It may become necessary to stop the administration of this medication or slow down the infusion rate if your blood pressure drops.
- **Allergic Reactions:** Patients can have an allergic reaction to this medication. Signs of a reaction can include: swelling, chills, fever, increased heart rate, shortness of breath or difficulty breathing, or a decrease in blood pressure. If you notice any changes in how you feel during the infusion, let your nurse know immediately. The infusion will be slowed or stopped if this occurs.
- **Radiation Recall:** Radiation recall is when the administration of a medication causes a skin reaction that looks like a sunburn (redness, swelling, soreness, peeling skin) in areas where radiation was previously given. Notify your oncology team if you notice this side effect. Treatment can include topical steroid ointments and a delay in your next chemotherapy dose.
- **Secondary Malignancies:** There is a very low risk of developing leukemia due to treatment with this medication, which can occur many years after treatment. This is most often associated with repeated treatments or high doses.

Sexual & Reproductive Concerns

This medication may affect your reproductive system, resulting in the menstrual cycle or sperm production becoming irregular or stopping permanently. Women may experience menopausal effects including hot flashes and [vaginal dryness](#). In addition, the desire for sex may decrease during treatment.

Exposure of an unborn child to this medication could cause birth defects, so you should not become pregnant or father a child while on this medication. Effective birth control is necessary during treatment and for at least 6 months for women and 4 months for men after treatment, even if your menstrual cycle stops or you believe you are not producing sperm. You may want to consider sperm banking or egg harvesting if you may wish to have a child in the future. Discuss these options with your oncology team. You should not breastfeed while receiving this medication.

Ifosfamide (Ifex®)

Content Contributor: Karen Arnold-Korzeniowski, BSN RN

Pronounce: eye-FOSS-fa-mide

Classification: Alkylating Agent

About Ifosfamide (Ifex®)

Ifosfamide exerts its anti-cancer effect by a process called alkylation. Alkylation damages the DNA of cells, which prevents them from dividing and causes them to die. Since cancer cells, in general, divide faster and with less error correcting than healthy cells, cancer cells are more sensitive to this damage.

How to Take Ifosfamide

Ifosfamide is given by intravenous (into a vein) infusion. The dosage and schedule are determined by the person's size and type of cancer. It can be given alone or with other drugs.

The blood levels of this medication can be affected by certain foods and medications, so they should be avoided. These include grapefruit, grapefruit juice, verapamil, ketoconazole, rifampin, phenytoin, St. John's wort, and fluconazole. Be sure to tell your healthcare provider about all medications and supplements you take.

Possible Side Effects of Ifosfamide

There are a number of things you can do to manage the side effects of ifosfamide. Talk to your care team about these recommendations. They can help you decide what will work best for you. These are some of the most common or important side effects:

Low White Blood Cell Count (Leukopenia or Neutropenia)

White blood cells (WBC) are important for fighting infection. While receiving treatment, your [WBC count can drop](#), putting you at a higher risk of getting an infection. You should let your doctor or nurse know right away if you have a fever (temperature greater than 100.4°F / 38°C), sore throat or cold, shortness of breath, cough, burning with urination, or a sore that doesn't heal.

Tips to preventing infection:

- [Washing hands](#), both yours and your visitors, is the best way to prevent the spread of infection.
- Avoid large crowds and people who are sick (i.e.: those who have a cold, fever, or cough or live with someone with these symptoms).
- When working in your yard, wear protective clothing including long pants and gloves.
- Do not handle pet waste.
- Keep all cuts or scratches clean.
- Shower or bathe daily and perform frequent [mouth care](#).
- Do not cut cuticles or ingrown nails. You may wear nail polish, but not fake nails.
- Ask your oncology care team before scheduling dental appointments or procedures.

- Ask your oncology care team before you, or someone you live with has any vaccinations.

Low Red Blood Cell Count (Anemia)

Your red blood cells are responsible for carrying oxygen to the tissues in your body. When the [red cell count is low](#), you may feel tired or weak. You should let your oncology care team know if you experience any shortness of breath, difficulty breathing, or pain in your chest. If the count gets too low, you may receive a blood transfusion.

Low Platelet Count (Thrombocytopenia)

Platelets help your blood clot, so when the [count is low](#) you are at a higher risk of bleeding. Let your oncology care team know if you have any excess bruising or bleeding, including nose bleeds, bleeding gums, or blood in your urine or stool. If the platelet count becomes too low, you may receive a transfusion of platelets.

- Do not use a razor (an electric razor is fine).
- Avoid contact sports and activities that can result in injury or bleeding.
- Do not take aspirin (salicylic acid), non-steroidal, anti-inflammatory medications (NSAIDs) such as Motrin/Advil (ibuprofen), Aleve (naproxen), Celebrex (celecoxib), etc. as these can all increase the risk of bleeding. Please consult with your healthcare team regarding the use of these agents and all over-the-counter medications/supplements while on therapy.
- Do not floss or use toothpicks and use a soft-bristle toothbrush to brush your teeth.

Nervous System Toxicity

In rare cases, ifosfamide can be toxic to the nervous system. Symptoms of this can include mild confusion, drowsiness, difficulty walking, blurry vision, hallucinations, personality changes, seizure, and coma. Toxicity can develop immediately after treatment up to several days later. Your caregiver should be aware of this rare side effect and know to report any changes in your behavior to your healthcare team right away.

Effect on Kidneys and Bladder

Ifosfamide can damage the kidneys. It can irritate or cause damage to the lining of the bladder, causing you to have blood in your urine. Intravenous fluids will be given with your treatment to flush the kidneys and bladder. A medication called Mesna will be given to protect the bladder lining. Your care team will monitor your kidney function with blood tests. Drink 6-8 glasses of fluid a day and try to urinate every 2-3 hours. Call your doctor or nurse if you have difficulty urinating or have blood in your urine.

Nausea and/or Vomiting

Talk to your oncology care team so they can prescribe medications to help you manage [nausea and vomiting](#). In addition, dietary changes may help. Avoid things that may worsen the symptoms, such as heavy or greasy/fatty, spicy, or acidic foods (lemons, tomatoes, oranges). Try saltines, or ginger ale to lessen symptoms.

Call your oncology care team if you are unable to keep fluids down for more than 12 hours or if you feel lightheaded or dizzy at any time.

Loss or Thinning of Scalp and Body Hair (Alopecia)

Your hair may become [thin, brittle, or may fall out](#). This typically begins two to three weeks after treatment starts. This hair loss can be all body hair, including pubic, underarm, legs/arms, eyelashes, and nose hairs. The use of scarves, wigs, hats, and hairpieces may help. Hair generally starts to regrow soon after treatment is completed. Remember your hair helps keep you warm in cold weather, so a hat is particularly important in cold weather or to protect you from the sun.

Less common, but important side effects can include:

- **Secondary Cancers:** A secondary cancer is one that develops as a result of cancer treatment for

another cancer. This is quite rare, but you should be aware of the risk. In most cases, a secondary cancer related to chemotherapy is a blood cancer (leukemia, lymphoma). This can occur years after treatment. This is most often associated with repeated treatments or high doses. Your provider will monitor your labs closely. Consider having a complete blood count with differential checked annually by your healthcare provider if you received high-risk therapies.

- **Lung Changes:** This medication may cause pulmonary fibrosis (scarring and stiffening of the lung tissue) or interstitial pneumonitis. These problems can develop months to years after treatment is completed and may be more common in people with pre-existing lung conditions. You may have breathing tests (pulmonary function tests) performed periodically. Call your physician right away if you have shortness of breath, cough, wheezing, or difficulty breathing.
- **Heart Problems:** Ifosfamide can cause or worsen pre-existing heart problems including congestive heart failure, arrhythmias, ST-segment and t-wave changes, pericardial effusion, pericarditis, decreased heart function, and heart attack. Notify your healthcare provider if you have sudden weight gain or swelling in the ankles or legs. If you develop chest pain or pressure, pain in the left arm, back, or jaw, sweating, shortness of breath, clammy skin, nausea, dizziness, or lightheadedness, call 911 or go to the nearest emergency room.
- **Liver Problems:** This medication can cause liver toxicity, which your oncology care team may monitor using blood tests called liver function tests. Notify your healthcare provider if you notice yellowing of the skin or eyes, your urine appears dark or brown, or you have pain in your abdomen, as these can be signs of liver toxicity. This medication, and when used in combination with other medications, may also potentially cause a serious side effect called veno-occlusive disease, also known as hepatic sinusoidal obstruction syndrome. This is caused by blockage of the blood flow through the small veins of the liver. Symptoms that should immediately be reported to your care team include yellowing of the skin or eyes, an enlarged liver which can lead to discomfort in the upper abdomen, weight gain, and fluid accumulation in the belly. The chance of having this side effect is higher if you are planning to receive a stem cell transplant after receiving this medication.
- **Allergic Reactions:** In some cases, patients can have an allergic reaction to this medication. Signs of a reaction can include shortness of breath or difficulty breathing, chest pain, rash, flushing or itching or a decrease in blood pressure. If you notice any changes in how you feel during the infusion, let your nurse know immediately.

Sexual & Reproductive Concerns

This drug may affect your reproductive system, resulting in the menstrual cycle or sperm production becoming irregular or stopping permanently. Women may experience menopausal effects including hot flashes and [vaginal dryness](#). In addition, the desire for sex may decrease during treatment.

Exposure of an unborn child to this medication could cause birth defects, so you should not become pregnant or father a child while on this medication. Effective birth control is necessary during treatment and for a 6 month period after treatment, even if your menstrual cycle stops or you believe you are not producing sperm. You may want to consider sperm banking or egg harvesting if you may wish to have a child in the future. Discuss these options with your oncology team. You should not breastfeed while taking this medication.

Methotrexate (Mexate®, Folex®, Rheumatrex®, Amethopterin, MTX)

Pronounce: meth-oh-TREKS-ate

Classification: Antimetabolite

About Methotrexate (Mexate®, Folex®, Rheumatrex®, Amethopterin, MTX)

Methotrexate interferes with DNA production. This stops cell growth and division, resulting in the slowing or stopping of cancer growth. Since cancer cells, in general, divide faster and with less error-correcting than healthy cells, cancer cells are more sensitive to this damage. Methotrexate competes with folic acid uptake in cells. This results in a folic acid deficiency in these cells and leads to cell death. By affecting the folic acid uptake, methotrexate also alters DNA replication and cell division. Cancer cells take up methotrexate faster than normal cells (because they are rapidly dividing and thus replicate their DNA more frequently), causing their cell death.

Leucovorin is given starting 24 hours after methotrexate. Leucovorin is also known as folinic acid and is converted into a derivative of folic acid in the body. Therefore, Leucovorin is given in an attempt to prevent healthy cells from taking up too much methotrexate, but on the other hand, allowing time for the methotrexate to get into cancer cells to cause their death.

How to Take Methotrexate

Methotrexate is given by intravenous (IV) infusion. In special situations, it may be injected into the spinal cord space (called intrathecal administration). It can also be given by mouth in the form of a tablet. The dosage is based on your body weight, medical condition, and the regimen your physician is using.

***If you have been prescribed leucovorin in combination with methotrexate and are unable to take it, keep it down, or miss a dose, call your healthcare team immediately.**

The blood levels of this medication can be affected by certain foods and medications, so they should be avoided. These include non-steroidal anti-inflammatory (NSAID) medications including ibuprofen, tetracycline, penicillin, sulfamethoxazole/trimethoprim, some other oral antibiotics, and folic acid. Be sure to tell your healthcare provider about all medications and supplements you take.

You, or anyone you live with, should avoid having live or live-attenuated vaccines while receiving this medication. These include herpes zoster (Zostavax) for shingles prevention, oral polio, measles, nasal flu vaccine (FluMist®), rotavirus, and yellow fever vaccines.

Possible Side Effects of Methotrexate

There are a number of things you can do to manage the side effects of Methotrexate. Talk to your care team about these recommendations. They can help you decide what will work best for you. These are some of the most common or important side effects:

Infection and Low White Blood Cell Count (Leukopenia or Neutropenia)

This medication can cause life-threatening infections, with or without a decrease in white blood cell counts.

White blood cells (WBC) are important for fighting infection. While receiving treatment, your [WBC count can drop](#), putting you at a higher risk of getting an infection. You should let your doctor or nurse know right away if you have a fever (temperature greater than 100.4°F or 38°C), sore throat or cold, shortness of breath, cough, burning with urination, or a sore that doesn't heal.

Tips to preventing infection:

- [Washing hands](#), both yours and your visitors, is the best way to prevent the spread of infection.
- Avoid large crowds and people who are sick (i.e.: those who have a cold, fever, or cough or live with someone with these symptoms).
- When working in your yard, wear protective clothing including long pants and gloves.
- Do not handle pet waste.
- Keep all cuts or scratches clean.

- Shower or bathe daily and perform frequent [mouth care](#).
- Do not cut cuticles or ingrown nails. You may wear nail polish, but not fake nails.
- Ask your oncology care team before scheduling dental appointments or procedures.
- Ask your oncology care team before you, or someone you live with has any vaccinations.

Nausea and/or Vomiting

Talk to your oncology care team so they can prescribe medications to help you manage [nausea and vomiting](#). In addition, dietary changes may help. Avoid things that may worsen the symptoms, such as heavy or greasy/fatty, spicy or acidic foods (lemons, tomatoes, oranges). Try saltines, or ginger ale to lessen symptoms.

Call your oncology care team if you are unable to keep fluids down for more than 12 hours or if you feel lightheaded or dizzy at any time.

Mouth Sores (Mucositis)

Certain cancer treatments can cause [sores or soreness in your mouth](#) and/or throat. Notify your oncology care team if your mouth, tongue, inside of your cheek or throat becomes white, ulcerated, or painful. Performing [regular mouth care](#) can help prevent or manage mouth sores. If mouth sores become painful, your doctor or nurse can recommend a pain reliever.

- Brush with a soft-bristle toothbrush or cotton swab twice a day.
- Avoid mouthwashes that contain alcohol. A baking soda and/or salt with warm water mouth rinse (2 level teaspoons of baking soda or 1 level teaspoon of salt in an eight-ounce glass of warm water) is recommended 4 times daily.
- If your mouth becomes dry, eat moist foods, drink plenty of fluids (6-8 glasses), and suck on sugarless hard candy.
- Avoid smoking and chewing tobacco, drinking alcoholic beverages, and citrus juices.

Diarrhea

Your oncology team can recommend medications to relieve [diarrhea](#). Also, try eating [low-fiber](#), bland foods, such as white rice and boiled or baked chicken. Avoid raw fruits, vegetables, whole-grain breads, cereals, and seeds. Soluble fiber is found in some foods and absorbs fluid, which can help relieve diarrhea. Foods high in soluble fiber include applesauce, bananas (ripe), canned fruit, orange sections, boiled potatoes, white rice, products made with white flour, oatmeal, cream of rice, cream of wheat, and farina. Drink 8-10 glasses of non-alcoholic, uncaffeinated fluid a day to prevent dehydration.

Low Red Blood Cell Count (Anemia)

Your red blood cells are responsible for carrying oxygen to the tissues in your body. When the [red cell count is low](#), you may feel tired or weak. You should let your oncology care team know if you experience any shortness of breath, difficulty breathing, or pain in your chest. If the count gets too low, you may receive a blood transfusion.

Low Platelet Count (Thrombocytopenia)

Platelets help your blood clot, so when the [count is low](#) you are at a higher risk of bleeding. Let your oncology care team know if you have any excess bruising or bleeding, including nose bleeds, bleeding gums, or blood in your urine or stool. If the platelet count becomes too low, you may receive a transfusion of platelets.

- Do not use a razor (an electric razor is fine).
- Avoid contact sports and activities that can result in injury or bleeding.
- Do not take aspirin (salicylic acid), non-steroidal, anti-inflammatory medications (NSAIDs) such as Motrin/Advil (ibuprofen), Aleve (naproxen), Celebrex (celecoxib), etc. as these can all increase the risk

of bleeding. Please consult with your healthcare team regarding the use of these agents and all over-the-counter medications/supplements while on therapy.

- Do not floss or use toothpicks and use a soft-bristle toothbrush to brush your teeth.

Fatigue

Fatigue is very common during cancer treatment and is an overwhelming feeling of exhaustion that is not usually relieved by rest. While on cancer treatment, and for a period after, you may need to adjust your schedule to manage fatigue. Plan times to rest during the day and conserve energy for more important activities. Exercise can help combat fatigue; a simple daily walk with a friend can help. Talk to your healthcare team for helpful tips on dealing with this side effect.

Loss or Thinning of Scalp and Body Hair (Alopecia)

Your hair may become **thin, brittle, or may fall out**. This typically begins two to three weeks after treatment starts. This hair loss can be all body hair, including pubic, underarm, legs/arms, eyelashes, and nose hairs. The use of scarves, wigs, hats, and hairpieces may help. Hair generally starts to regrow soon after treatment is completed. Remember your hair helps keep you warm in cold weather, so a hat is particularly important in cold weather or to protect you from the sun.

Nail and Skin Changes

Your fingernails/toenails may become dark, brittle, or fall off. Keep your fingernails and toenails clean and dry. You may use nail polish but do not wear fake nails (gels, acrylics, overlay). If any nails fall off, clean the nail bed well with soap and water and cover with a band-aid.

You may notice dry skin or changes in the color or tone of your skin. Your skin may be more sensitive to the sun, which can result in severe sunburn or rash. Sun sensitivity can last even after chemotherapy is completed. Avoid the sun between 10-2 p.m., when it is strongest. Wear sunscreen (at least SPF 30 with UVA/UVB protection) every day and reapply when in the sun for extended periods of time; wear sunglasses with UVA/UVB protection, a hat, and long sleeves/pants to protect your skin and seek out shade whenever possible.

Secondary Malignancies

There is a very low risk of developing leukemia, sarcoma, lung cancer, or other types of cancer due to treatment with this medication, which can occur many years after treatment. This is most often associated with repeated treatments or high doses.

Kidney Problems

This medication can cause kidney problems, including an increased creatinine level, which your oncology care team may monitor for using blood tests. Notify your healthcare provider if you notice decreased urine output, blood in the urine, swelling in the ankles, or loss of appetite.

Tumor Lysis Syndrome

If there are a large number of tumor cells in your body prior to treatment, you are at risk for tumor lysis syndrome. This happens when the tumor cells die too quickly and their waste overwhelms the body. You may be given a medication (allopurinol) and IV fluids to help prevent this. If you experience nausea, vomiting, diarrhea, or become lethargic (drowsy, sluggish), notify your oncology team right away. TLS can affect your kidney function. Your provider will monitor your kidney function with blood work. Notify your provider if you have little or no urine output.

Radiation Recall

Radiation recall is when the administration of a medication causes a skin reaction that looks like a sunburn (redness, swelling, soreness, peeling skin) in areas where radiation was previously given. Notify your oncology team if you notice this side effect. Treatment can include topical steroid ointments and a delay in your next chemotherapy dose.

Less common, but important side effects can include:

- **Lung Changes:** This medication can cause an opportunistic infection called pneumocystis pneumonia. It can also cause interstitial pneumonitis, particularly when high doses have been received. Interstitial pneumonitis can develop months to years after treatment is completed and may be more common in people with pre-existing lung conditions. Notify your healthcare provider if you develop fever, shortness of breath, non-productive cough, wheezing, or difficulty breathing.
- **Liver Toxicity:** This medication can cause liver toxicity, which your oncology care team may monitor using blood tests called liver function tests. Notify your healthcare provider if you notice yellowing of the skin or eyes, your urine appears dark or brown, or you have pain in your abdomen, as these can be signs of liver toxicity.
- **Eye Problems:** This medication can cause your eyes to become irritated or watery and you may be more sensitive to light. Notify your provider if you develop any eye changes.
- **Neurologic changes:** This medication can affect the nervous system, causing you to feel drowsy, dizzy, or confused. Notify your provider if you are feeling different.

Sexual & Reproductive Concerns

This medication may affect your reproductive system, resulting in the menstrual cycle or sperm production becoming irregular or stopping permanently. Women may experience menopausal effects including hot flashes and [vaginal dryness](#). In addition, the desire for sex may decrease during treatment. You may want to consider sperm banking or egg harvesting if you wish to have a child in the future. Discuss these options with your oncology team.

Exposure of an unborn child to this medication could cause birth defects, so you should not become pregnant or father a child while on this medication. Effective birth control is necessary during treatment and for at least 3 months after treatment for men and during treatment and for at least 6 months for women, even if your menstrual cycle stops or you believe you are not producing sperm. You should not breastfeed while receiving this medication.

Intrathecal (Spinal) Administration

When injected into the spinal cord space, methotrexate can cause headache, vomiting, fever, or stiff neck. In rare cases, intrathecal administration can cause neurotoxicity, which presents with paralysis, speech difficulty, seizures, or coma. This can occur up to several days after the treatment and resolves in a few days.

Methotrexate Oral Formulation (Trexall®, Rheumatrex®, MTX)

Pronounce: meth-oh-TREK-sate

Classification: Antimetabolite

About Methotrexate Oral Formulation (Trexall®, Rheumatrex®, MTX)

Methotrexate interferes with DNA production. This stops cell growth and division, resulting in the slowing or stopping of cancer growth. Since cancer cells, in general, divide faster and with less error-correcting than healthy cells, cancer cells are more sensitive to this damage. Methotrexate competes with folic acid uptake in cells. This results in a folic acid deficiency in these cells and leads to cell death. By affecting the folic acid uptake, methotrexate also alters DNA replication and cell division. Cancer cells take up methotrexate faster than normal cells (because they are rapidly dividing and thus replicate their DNA more frequently), causing their cell death.

Depending on your diagnosis, you may also receive leucovorin starting 24 hours after methotrexate.

Leucovorin is also known as folinic acid and is converted into a derivative of folic acid in the body. Therefore, leucovorin is given in an attempt to prevent healthy cells from taking up too much methotrexate, while allowing time for the methotrexate to get into cancer cells to cause their death.

How to Take Oral Methotrexate

Methotrexate comes in a tablet taken by mouth. Your dosing schedule will depend on the disease being treated as well as how your body responds to the medication. It is important to follow your healthcare team's dosage instructions carefully. You should not take larger or smaller amounts than prescribed by your healthcare provider.

It is important to make sure you are taking the correct amount of medication every time. Before every dose, check that what you are taking matches what you have been prescribed.

The blood levels of this medication can be affected by certain foods and medications, so they should be avoided. These include: non-steroidal anti-inflammatory (NSAID) medications including ibuprofen, tetracycline, penicillin, sulfamethoxazole/trimethoprim, and other oral antibiotics and folic acid. Be sure to tell your healthcare provider about all medications and supplements you take.

****If you have been prescribed leucovorin in combination with methotrexate and are unable to take it, keep it down or miss a dose, call your healthcare team immediately.***

You, or anyone you live with, should avoid having live or live-attenuated vaccines while receiving this medication. These include herpes zoster (Zostavax) for shingles prevention, oral polio, measles, nasal flu vaccine (FluMist®), rotavirus, and yellow fever vaccines.

Storage and Handling

Store your medication in the original, labeled container at room temperature and in a dry location (unless otherwise directed by your healthcare provider or pharmacist). This medication should not be stored in a pillbox. Keep containers out of reach of children and pets.

If a caregiver prepares your dose for you, they should consider wearing gloves or pour the pills directly from their container into the cap, a small cup, or directly into your hand. They should avoid touching the pills. They should always wash their hands before and after giving you the medication. Pregnant or nursing women should not prepare the dose for you. Ask your oncology team where to return any unused medication for disposal. Do not flush it down the toilet or throw it in the trash.

Where do I get this medication?

Depending on your prescription insurance coverage, oral methotrexate may be available at a retail pharmacy or through a specialty pharmacy. Your oncology team will work with your prescription drug plan to identify an in-network pharmacy for the distribution of this medication.

Insurance Information

This medication may be covered under your prescription drug plan. Patient assistance may be available to qualifying individuals without prescription drug coverage. Co-pay cards, which reduce the patient's co-pay responsibility for eligible commercially (non-government sponsored) insured patients, are also offered by the manufacturer. Co-pay assistance from private third party foundations may be available. Your care team can help you access these resources if they are available.

This medication is covered under Medicare part B for Medicare recipients. Make sure your pharmacist knows to process this prescription through your Medicare part B and NOT part D.

Possible Side Effects of Methotrexate

There are a number of things you can do to manage the side effects of Methotrexate. Talk to your care team about these recommendations. They can help you decide what will work best for you. These are some of the most common or important side effects:

Allergic Reactions

In some cases, patients can have an allergic reaction to this medication. Signs of a reaction can include: shortness of breath or difficulty breathing, chest pain, rash, flushing or itching, or a decrease in blood pressure. If you notice any changes in how you feel, let your provider know immediately. This medication can also severely affect your bone marrow, gastrointestinal tract, liver, lungs, skin, and kidneys. It is important to notify your provider of any new symptoms or side effects you are having.

Nausea and/or Vomiting

Talk to your care team so they can prescribe medications to help you manage [nausea and vomiting](#). In addition, dietary changes may help. Avoid things that may worsen the symptoms, such as heavy or greasy/fatty, spicy or acidic foods (lemons, tomatoes, oranges). Try antacids, (e.g. milk of magnesia, calcium tablets such as Tums), saltines, or ginger ale to lessen symptoms.

Call your doctor or nurse if you are unable to keep fluids down for more than 12 hours or if you feel lightheaded or dizzy at any time.

Diarrhea

Your oncology team can recommend medications to relieve [diarrhea](#). Also, try eating [low-fiber](#), bland foods, such as white rice and boiled or baked chicken. Avoid raw fruits, vegetables, whole grain breads, cereals, and seeds. Soluble fiber is found in some foods and absorbs fluid, which can help relieve diarrhea. Foods high in soluble fiber include: applesauce, bananas (ripe), canned fruit, orange sections, boiled potatoes, white rice, products made with white flour, oatmeal, cream of rice, cream of wheat, and farina. Drink 8-10 glasses of non-alcoholic, un-caffeinated fluid a day to prevent dehydration.

Low White Blood Cell Count (Leukopenia or Neutropenia)

White blood cells (WBC) are important for fighting infection. While receiving treatment, your [WBC count can drop](#), putting you at a higher risk of getting an infection. You should let your doctor or nurse know right away if you have a fever (temperature greater than 100.4°F or 38°C), sore throat or cold, shortness of breath, cough, burning with urination, or a sore that doesn't heal.

Tips to preventing infection:

- [Washing hands](#), both yours and your visitors, is the best way to prevent the spread of infection.
- Avoid large crowds and people who are sick (i.e.: those who have a cold, fever or cough or live with someone with these symptoms).
- When working in your yard, wear protective clothing including long pants and gloves.
- Do not handle pet waste.
- Keep all cuts or scratches clean.
- Shower or bath daily and perform frequent [mouth care](#).
- Do not cut cuticles or ingrown nails. You may wear nail polish, but not fake nails.
- Ask your oncology care team before scheduling dental appointments or procedures.
- Ask your oncology care team before you, or someone you live with has any vaccinations.

Low Red Blood Cell Count (Anemia)

Your red blood cells are responsible for carrying oxygen to the tissues in your body. When the [red cell count is low](#), you may feel tired or weak. You should let your oncology care team know if you experience any shortness of breath, difficulty breathing, or pain in your chest. If the count gets too low, you may receive a blood

transfusion.

Low Platelet Count (Thrombocytopenia)

Platelets help your blood clot, so when the [count is low](#) you are at a higher risk of bleeding. Let your oncology care team know if you have any excess bruising or bleeding, including nose bleeds, bleeding gums, or blood in your urine or stool. If the platelet count becomes too low, you may receive a transfusion of platelets.

- Do not use a razor (an electric razor is fine).
- Avoid contact sports and activities that can result in injury or bleeding.
- Do not take aspirin (salicylic acid), non-steroidal, anti-inflammatory medications (NSAIDs) such as Motrin/Advil (ibuprofen), Aleve (naproxen), Celebrex (celecoxib) etc. as these can all increase the risk of bleeding. Please consult with your healthcare team regarding use of these agents and all over the counter medications/supplements while on therapy.
- Do not floss or use toothpicks and use a soft-bristle toothbrush to brush your teeth.

Mouth Sores (Mucositis)

Certain cancer treatments can cause [sores or soreness in your mouth](#) and/or throat. Notify your oncology care team if your mouth, tongue, inside of your cheek or throat becomes white, ulcerated or painful. Performing [regular mouth care](#) can help prevent or manage mouth sores. If mouth sores become painful, your doctor or nurse can recommend a pain reliever.

- Brush with a soft-bristle toothbrush or cotton swab twice a day.
- Avoid mouthwashes that contain alcohol. A baking soda and/or salt with warm water mouth rinse (2 level teaspoons of baking soda or 1 level teaspoon of salt in an eight ounce glass of warm water) is recommended 4 times daily.
- If your mouth becomes dry, eat moist foods, drink plenty of fluids (6-8 glasses), and suck on sugarless hard candy.
- Avoid smoking and chewing tobacco, drinking alcoholic beverages, and citrus juices.

Loss or Thinning of Scalp and Body Hair (Alopecia)

Your hair may become [thin, brittle, or may fall out](#). This typically begins two to three weeks after treatment starts. This hair loss can be all body hair, including pubic, underarm, legs/arms, eyelashes, and nose hairs. The use of scarves, wigs, hats, and hairpieces may help. Hair generally starts to regrow soon after treatment is completed. Remember your hair helps keep you warm in cold weather, so a hat is particularly important in cold weather or to protect you from the sun.

Nail and Skin Changes

Your fingernails/toenails may become dark, brittle, or fall off. Keep your fingernails and toenails clean and dry. You may use nail polish, but do not wear fake nails (gels, acrylics, overlay). If any nails fall off, clean the nail bed well with soap and water and cover with a band aid.

You may notice dry skin or changes in the color or tone of your skin. Your skin may be more sensitive to the sun, which can result in severe sunburn or rash. Sun sensitivity can last even after chemotherapy is completed. Avoid the sun between 10-2pm, when it is strongest. Wear sunscreen (at least SPF 30 with UVA/UVB protection) every day and reapply when in the sun for extended periods of time); wear sunglasses with UVA/UVB protection, a hat, and long sleeves/pants to protect your skin and seek out shade whenever possible.

Secondary Malignancies

There is a very low risk of developing leukemia, sarcoma, lung cancer, or other types of cancer due to treatment with this medication, which can occur many years after treatment. This is most often associated with repeated treatments or high doses.

Kidney Problems

This medication can cause kidney problems, including an increased creatinine level, which your oncology care team may monitor for using blood tests. Notify your healthcare provider if you notice decreased urine output, blood in the urine, swelling in the ankles, or loss of appetite.

Tumor Lysis Syndrome

If there are a large amount of tumor cells in your body prior to treatment, you are at risk for tumor lysis syndrome. This happens when the tumor cells die too quickly and their waste overwhelms the body. You may be given a medication (allopurinol) and IV fluids to help prevent this. If you experience nausea, vomiting, diarrhea, or become lethargic (drowsy, sluggish), notify your oncology team right away. TLS can affect your kidney function. Your provider will monitor your kidney function with blood work. Notify your provider if you have little or no urine output.

Radiation Recall

Radiation recall is when the administration of a medication causes a skin reaction that looks like a sunburn (redness, swelling, soreness, peeling skin) in areas where radiation was previously given. Notify your oncology team if you notice this side effect. Treatment can include topical steroid ointments and a delay in your next chemotherapy dose.

Less common, but important side effects can include:

- **Lung Changes:** This medication can cause an opportunistic infection called pneumocystis pneumonia. This medication can also cause interstitial pneumonitis, particularly when high doses have been received. Interstitial pneumonitis can develop months to years after treatment is completed and may be more common in people with pre-existing lung conditions. Call your oncology care team right away if you have shortness of breath, cough, wheezing or difficulty breathing.
- **Liver Toxicity:** This medication can cause liver toxicity, which your oncology care team may monitor for using blood tests called liver function tests. Notify your healthcare provider if you notice yellowing of the skin or eyes, your urine appears dark or brown, or you have pain in your abdomen, as these can be signs of liver toxicity,
- **Eye Problems:** This medication can cause your eyes to become irritated or watery and you may be more sensitive to light. Notify your provider if you develop any eye changes.
- **Neurologic changes:** This medication can affect the nervous system, causing you to feel drowsy, dizzy, or confused. Notify your provider if you are feeling different.

Sexual & Reproductive Concerns

This medication may affect your reproductive system, resulting in the menstrual cycle or sperm production becoming irregular or stopping permanently. Women may experience menopausal effects including hot flashes and [vaginal dryness](#). In addition, the desire for sex may decrease during treatment. You may want to consider sperm banking or egg harvesting if you may wish to have a child in the future. Discuss these options with your oncology team.

Exposure of an unborn child to this medication could cause birth defects, so you should not become pregnant or father a child while on this medication. Effective birth control is necessary during treatment and for at least 6 months after treatment for women and 3 months after treatment for men. Even if your menstrual cycle stops or you believe you are not producing sperm. You should not breastfeed while receiving this medication or for one week after your last dose.

OncoLink is designed for educational purposes only and is not engaged in rendering medical advice or professional services. The information provided through OncoLink should not be used for diagnosing or treating a health problem or a disease. It is not a substitute for professional care. If you have or suspect you may have a health problem or have questions or concerns about the medication that you have been prescribed, you should consult your health care provider.