Immunotherapy

Immunotherapy is treatment that uses a person's own immune system to fight cancer. Immunotherapy can boost or change how the immune system works so it can find and attack cancer cells. If your treatment plan includes immunotherapy, knowing how it works and what to expect can often help you prepare for treatment and make informed decisions about your care.

How Immunotherapy Is Used to Treat Cancer

Immunotherapy is treatment that uses certain parts of a person’s immune system to fight diseases such as cancer. This can be done in a couple of ways:

- Stimulating, or boosting, the natural defenses of your immune system so it works

harder or smarter to find and attack cancer cells
- Making substances in a lab that are just like immune system components and using them to help restore or improve how your immune system works to find and attack cancer cells

In the last few decades immunotherapy has become an important part of treating some types of cancer. New immunotherapy treatments are being tested and approved, and new ways of working with the immune system are being discovered at a very fast pace.

Immunotherapy works better for some types of cancer than for others. It's used by itself for some of these cancers, but for others it seems to work better when used with other types of treatment.

What the immune system does

Your immune system is a collection of organs, special cells, and substances that help protect you from infections and some other diseases. Immune cells and the substances they make travel through your body to protect it from germs that cause infections. They also help protect you from cancer in some ways.

The immune system keeps track of all of the substances normally found in the body. Any new substance that the immune system doesn't recognize raises an alarm, causing the immune system to attack it. For example, germs contain substances such as certain proteins that are not normally found in the human body. The immune system sees these as "foreign" and attacks them. The immune response can destroy anything containing the foreign substance, such as germs or cancer cells.

The immune system has a tougher time targeting cancer cells, though. This is because cancer starts when normal, healthy cells become changed or altered and start to grow out of control. Because cancer cells actually start in normal cells, the immune system doesn't always recognize them as foreign.

Clearly there are limits on the immune system's ability to fight cancer on its own, because many people with healthy immune systems still develop cancer:

- Sometimes the immune system doesn't see the cancer cells as foreign because the cells aren't different enough from normal cells.
- Sometimes the immune system recognizes the cancer cells, but the response might not be strong enough to destroy the cancer.
- Cancer cells themselves can also give off substances that keep the immune system

from finding and attacking them.

To overcome this, researchers have found ways to help the immune system recognize cancer cells and strengthen its response so that it will destroy them. In this way, your own body is actually getting rid of the cancer, with some help from science.

Types of cancer immunotherapy

There are several main types of immunotherapy used to treat cancer, and many are being studied. **For more information about immunotherapy as a treatment for a specific cancer, please see Cancer A-Z and choose a cancer type[1].**

- Checkpoint inhibitors**:** These drugs basically take the ‘brakes’ off the immune system, which helps it recognize and attack cancer cells.
- Chimeric antigen receptor (CAR) T-cell therapy**:** This therapy takes some T-cells from a patient's blood, mixes them with a special virus that makes the T-cells learn how to attach to tumor cells, and then gives the cells back to the patient so they can find, attach to, and kill the cancer.
- **Cytokines**: This treatment uses *cytokines* (small proteins that carry messages between cells) to stimulate the immune cells to attack cancer.
- **Immunomodulators**: This group of drugs generally boosts parts of the immune system to treat certain types of cancer.
- Cancer vaccines**:** Vaccines are substances put into the body to start an immune response against certain diseases. We usually think of them as being given to healthy people to help prevent infections. But some vaccines can help prevent or treat cancer.
- Monoclonal antibodies **(mAbs or MoAbs):** These are man-made versions of immune system proteins. mAbs can be very useful in treating cancer because they can be designed to attack a very specific part of a cancer cell.
- **Oncolytic viruses**: This treatment uses viruses that have been modified in a lab to infect and kill certain tumor cells..

Hyperlinks

1. www.cancer.org/cancer/all-cancer-types.html

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

Monoclonal Antibodies and Their Side

Effects

One way the body's immune system attacks foreign substances is by making large numbers of antibodies. An antibody is a protein that sticks to a specific protein called an *antigen*. Antibodies circulate throughout the body until they find and attach to the antigen. Once attached, they can force other parts of the immune system to destroy the cells containing the antigen.

Researchers can design antibodies that specifically target a certain antigen, such as one found on cancer cells. They can then make many copies of that antibody in the lab. These are known as *monoclonal antibodies* (mAbs or Moabs).

Monoclonal antibodies are used to treat many diseases, including some types of cancer. To make a monoclonal antibody, researchers first have to identify the right antigen to attack. Finding the right antigens for cancer cells is not always easy, and so far mAbs have proven to be more useful against some cancers than others.

NOTE: Some monoclonal antibodies used to treat cancer are referred to as *targeted therapy*[1] because they have a specific target on a cancer cell that they aim to find, attach to, and attack. But other monoclonal antibodies act like immunotherapy because they make the immune system respond better to allow the body to find and attack cancer cells more effectively.

What mAbs are made of

Monoclonal antibodies are man-made proteins that act like human antibodies in the immune system. There are 4 different ways they can be made and are named based on what they are made of.

- **Murine:** These are made from mouse proteins and the names of the treatments end in -omab.
- **Chimeric:** These proteins are a combination of part mouse and part human and the names of the treatments end in -ximab.
- **Humanized:** These are made from small parts of mouse proteins attached to human proteins and the names of the treatments end in -zumab
- **Human:** These are fully human proteins and the names of the treatments end in -umab.

Types of mAbsused to treat cancer

Naked monoclonal antibodies

Naked mAbs are antibodies that have no drug or radioactive material attached to them. They work by themselves. These are the most common type of mAbs used to treat cancer. Most naked mAbs attach to antigens on cancer cells, but some work by binding to antigens on other, non-cancerous cells, or even free-floating proteins. Naked mAbs can work in different ways.

- Some boost a person's immune response against cancer cells by attaching to them and acting as a marker for the body's immune system to destroy them. An example is alemtuzumab (Campath®), which is used to treat some patients with chronic lymphocytic leukemia[2] (CLL).Alemtuzumab binds to the CD52 antigen, which is found on cells called *lymphocytes* (which include the leukemia cells). Once attached, the antibody attracts immune cells to destroy these cells.
- Some naked mAbs boost the immune response by targeting immune system checkpoints. (See Immune Checkpoint Inhibitors and Their Side Effects.)
- Other naked mAbs work mainly by attaching to and blocking antigens on cancer cells (or other nearby cells) that help cancer cells grow or spread. For example, trastuzumab (Herceptin) is an antibody against the HER2 protein. Breast and stomach cancer cells sometimes have large amounts of this protein on their surface. When HER2 is activated, it helps these cells grow. Trastuzumab binds to these proteins and stops them from becoming active.

Conjugated monoclonal antibodies

Conjugated mAbs are combined with a chemotherapy drug or a radioactive particle. These mAbs are used as a homing device to take one of these substances directly to the cancer cells. The mAb circulates throughout the body until it can find and hook onto the target antigen. It then delivers the toxic substance where it is needed most. This lessens the damage to normal cells in other parts of the body. Conjugated mAbs are also sometimes referred to as *tagged*, *labeled*, or *loaded* antibodies.

- **Radiolabeled antibodies:** Radiolabeled antibodies have small radioactive particles attached to them. Ibritumomab tiuxetan (Zevalin) is an example of a radiolabeled mAb. This is an antibody against the CD20 antigen, which is found on lymphocytes called *B cells*. The antibody delivers radioactivity directly to cancer cells. It is made

of both an mAb drug (rituximab) and a radioactive substance (Yttrium-90). Treatment with this type of antibody is sometimes known as *radioimmunotherapy* (RIT). The drug and radiation are delivered directly to the target cells because the mAb looks for the target, then the radiation affects the target and nearby cells to a certain extent.

- **Chemolabeled antibodies:** These mAbs have powerful chemotherapy (or other) drugs attached to them. Examples include: Brentuximab vedotin (Adcetris), an antibody that targets the CD30 antigen (found on lymphocytes), attached to a chemo drug called *MMAE*.Ado-trastuzumab emtansine (Kadcyla, also called TDM-1), an antibody that targets the HER2 protein, attached to a chemo drug called DM1.

Bispecific monoclonal antibodies

These drugs are made up of parts of 2 different mAbs, meaning they can attach to 2 different proteins at the same time. An example is blinatumomab (Blincyto), which is used to treat some types of leukemia. One part of blinatumomab attaches to the CD19 protein, which is found on some leukemia and lymphoma cells. Another part attaches to CD3, a protein found on immune cells called *T cells*. By binding to both of these proteins, this drug brings the cancer cells and immune cells together, which is thought to cause the immune system to attack the cancer cells.

Possible side effects of monoclonal antibodies

Monoclonal antibodies are given intravenously (injected into a vein). The antibodies themselves are proteins, so giving them can sometimes cause something like an allergic reaction. This is more common while the drug is first being given. Possible side effects[3] can include:

- Fever
- Chills
- Weakness
- Headache
- Nausea
- Vomiting
- Diarrhea
- Low blood pressure
- Rashes

Compared with chemotherapy drugs, naked mAbs tend to have fewer serious side effects. But they can still cause problems in some people. Some mAbs can have side effects that are related to the antigens they target. For example:

- Bevacizumab (Avastin) is an mAb that targets a protein called *VEGF* that affects tumor blood vessel growth. It can cause side effects such as high blood pressure, bleeding, poor wound healing, blood clots, and kidney damage.
- Cetuximab (Erbitux) is an antibody that targets a cell protein called *EGFR*, which is found on normal skin cells (as well as some types of cancer cells). This drug can cause serious rashes in some people.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/targeted-therapy.html
2. www.cancer.org/cancer/chronic-lymphocytic-leukemia.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

CAR T-cell Therapy and Its Side Effects

Your immune system works by keeping track of all the substances normally found in your body. Any new substance the immune system doesn't recognize raises an alarm, causing the immune system to attack it. **Chimeric antigen receptor (CAR) T-cell therapy** is a promising new way to get immune cells called *T cells*(a type of white blood cell)to fight cancer by changing them in the lab so they can find and destroy cancer cells. CAR T-cell therapies are sometimes talked about as a type of *gene* or *cell therapy*, or *immune effect cell therapy*.

How CAR T-cell therapy works

Immune receptors and foreign antigens

The immune system recognizes foreign substances in the body by finding proteins called *antigens* on the surface of those cells. Immune cells called *T cells* have their own proteins called *receptors* that attach to foreign antigens and help trigger other parts of the immune system to destroy the foreign substance.

The relationship between antigens and immune receptors is like a lock and key. Just as every lock can only be opened with the right key, each foreign antigen has a unique immune receptor that is able to bind to it. Cancer cells also have antigens, but if your immune cells do not have the right receptors, they cannot attach to the antigens and help destroy the cancer cells.

Chimeric antigen receptors (CARs)

The T cells used in CAR T-cell therapies get changed in the lab by adding a man-made receptor (called a *chimeric antigen receptor* or *CAR*). This helps them better identify specific cancer cell antigens. Since different cancers have different antigens, each CAR is made for a specific cancer's antigen. For example, certain kinds of leukemia or lymphoma will have an antigen on the outside of the cancer cells called CD19. The CAR T-cell therapies to treat those cancers are made to connect to the CD-19 antigen and will not work for a cancer that does not have the CD19 antigen. The patient's own T cells are used to make the CAR T cells.

Getting CAR T-cell therapy

The process for CAR T-cell therapy can take a few weeks.

Collecting the T cells

First, white blood cells (which include T cells) are removed from the patient’s blood using a procedure called *leukapheresis*. During this procedure, patients usually lie in bed or sit in a reclining chair. Two IV lines are needed because blood is removed through one line, and then put back into the bloodstream through the other line, after the white blood cells have been removed. Sometimes a special type of IV line is used called a *central venous catheter*[1], that has both IV lines built in. The patient will need to stay still for 2 to 3 hours during the procedure. Sometimes calcium levels can drop during leukapheresis, which can cause numbness and tingling or muscle spasms. This can be easily treated with calcium, which may be given by mouth or through an IV .

Making the CAR T cells

After the white cells are removed, the T-cells are separated, sent to the lab, and genetically altered by adding the specific chimeric antigen receptor (CAR). This makes them CAR T cells. It can take a few weeks to make the large number of CAR T cells needed for this therapy.

Receiving the CAR T-cell infusion

Once enough CAR T cells have been made, they will be given back to the patient to launch a precise attack against the cancer cells. A few days before a CAR T-cell infusion, the patient might be given chemotherapy[2] to help lower the number of other immune cells. This gives the CAR T cells a better chance to get activated to fight the cancer. This chemotherapy is usually not very strong because CAR T cells work best when there are some cancer cells to attack. Once the CAR T cells start binding with cancer cells, they start to increase in number and can destroy even more cancer cells.

Approved CAR T-cell therapies

CAR T-cell therapy is FDA approved for some kinds of lymphomas, and for certain patients with relapsed or hard to treat leukemia. Many clinical trials are underway with the hope of treating even more patients. One problem with some types of cancer is that they don't have the same antigens for the CAR T cell to work with because the proteins are inside the cells, not on the cell surface. This may mean that the CAR T cell needs a special "armor" to be able to get into the cell to work. More research is needed to study this.

Examples of CAR T-cell therapies currently approved include:

- Tisagenlecleucel (Kymriah)
- Axicabtagene ciloleucel (Yescarta)
- Brexucabtagene autoleucel (Tecartus)

CAR T-cell therapy side effects

Some people have had serious side effects from this treatment, especially as the CAR T cells multiply in the body to fight the cancer. As CAR T cells multiply, they cause massive amounts of chemicals called *cytokines* to be released into the blood. Serious side effects of this release can include very high fevers and dangerously low blood pressure in the days after treatment is given. This is called **cytokine release syndrome**, or **CRS**. Even though it can be a scary side effect, it's important to remember that it means the CAR T cells are working. And as doctors have gained more experience with CAR T-cell therapy, they have learned how to recognize this side effect early, as well as how to treat it.

Other serious side effects[3] include neurotoxicity or changes in the brain that cause

swelling, confusion, seizures, or severe headaches.

One other problem is that the CAR T cells can kill off some of the good B cells that help fight germs, so the patient may be at higher risk for infection.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/planning-managing/tubes-lines-ports-catheters.html
2. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Last Medical Review: December 27, 2019 Last Revised: July 24, 2020

Immune Checkpoint Inhibitors and Their Side Effects

An important function of the immune system is its ability to tell between normal cells in the body and those it sees as “foreign.” This lets the immune system attack the foreign cells while leaving the normal cells alone. To do this, it uses “checkpoints.” Immune checkpoints are molecules on certain immune cells that need to be activated (or inactivated) to start an immune response.

Cancer cells sometimes find ways to use these checkpoints to avoid being attacked by the immune system. But drugs that target these checkpoints hold a lot of promise as cancer treatments. These drugs are called *checkpoint inhibitors*.

It's important to know that checkpoint inhibitors used to treat cancer don't work directly on the tumor at all. They only take the brakes off an immune response that has begun but hasn't yet been working at its full force.

Checkpoint inhibitor drugs that target PD-1 or PD-L1

PD-1 is a checkpoint protein on immune cells called *T cells*. It normally acts as a type of “off switch” that helps keep the T cells from attacking other cells in the body. It does this when it attaches to PD-L1, a protein on some normal (and cancer) cells. When PD-1 binds to PD-L1, it basically tells the T cell to leave the other cell alone. Some cancer cells have large amounts of PD-L1, which helps them hide from an immune attack.

Monoclonal antibodies that target either PD-1 or PD-L1 can block this binding and boost the immune response against cancer cells. These drugs have shown a great deal of promise in treating certain cancers.

PD-1 inhibitors: These drugs are given by IV (intravenously). Examples of drugs that target PD-1 include:

- Pembrolizumab (Keytruda)
- Nivolumab (Opdivo)
- Cemiplimab (Libtayo)

These drugs have been shown to be helpful in treating several types of cancer, and new cancer types are being added as more studies show these drugs to be effective.

PD-L1 inhibitors: Examples of drugs that target PD-L1 include:

- Atezolizumab (Tecentriq)
- Avelumab (Bavencio)
- Durvalumab (Imfinzi)

These drugs have also been shown to be helpful in treating different types of cancer, and are being studied for use against others.

Checkpoint inhibitor drugs that target CTLA-4

CTLA-4 is another protein on some T cells that acts as a type of “off switch” to keep the immune system in check.

Ipilimumab (Yervoy) is a monoclonal antibody that attaches to CTLA-4 and stops it from working. This can boost the body’s immune response against cancer cells.

This drug is used to treat melanoma of the skin and continues to be tested for other cancers.

Side effects of checkpoint inhibitors

The most common side effects[1] of checkpoint inhibitors are:

- Diarrhea
- Pneumonitis (inflammation in the lungs)
- Rashes and itchiness
- Problems with some hormone levels
- Kidney infections

If the side effects are severe, your doctor might delay giving the checkpoint inhibitor for a period of time to allow the body to recover. Less severe side effects can often be helped with medications.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

Cancer Vaccines and Their Side Effects

Most of us know about vaccines given to healthy people to help prevent infections, such as measles and chicken pox. These vaccines use weakened or killed germs like viruses or bacteria to start an immune response in the body. Getting the immune system ready to defend against these germs helps keep people from getting infections.

Most vaccines used to treat cancer work the same way, but they make the person's immune system attack cancer cells. The goal is to help treat cancer or to help keep it from coming back after other treatments. But there are also some vaccines that may actually help prevent certain cancers.

Vaccines to help prevent cancer

Some cancers are caused by viruses. Vaccines that help protect against infections with these viruses might also help prevent some of these cancers.

- Some strains of the human papillomavirus (HPV)[1] have been linked to cervical, anal, throat, vaginal, vulvar, and penile cancers. In fact, most cervical cancers are caused by infection with HPV. Vaccinating children and certain young adults against HPV helps protect against cervical cancer and the other 5 cancers HPV can cause. Read more in Protect Against HPV[2].
- People who have chronic (long-term) infections with the hepatitis B virus (HBV) are at higher risk for liver cancer[3]. Getting the vaccine to help prevent HBV infection may lower some people's risk of getting liver cancer.

These are traditional preventive vaccines that target the viruses that can cause certain cancers. They may help protect against some cancers, but they don't target cancer cells directly because cancer cells have not yet been formed or found.

These types of vaccines are only useful for cancers known to be caused by infections. But most cancers, including colorectal, lung, prostate, and breast cancers, are not thought to be caused by infections.

Vaccines to treat cancer

Cancer treatment vaccines are different from the vaccines that work against viruses. These vaccines try to get the immune system to mount an attack against cancer cells in the body. Instead of preventing disease, they are meant to get the immune system to attack a disease that already exists.

Some cancer treatment vaccines are made up of cancer cells, parts of cells, or pure antigens (certain proteins on the cancer cells). Sometimes a patient's own immune cells are removed and exposed to these substances in the lab to create the vaccine. Once the vaccine is ready, it's injected into the body to increase the immune response against cancer cells.

Vaccines are often combined with other substances or cells called *adjuvants* that help boost the immune response even further.

Cancer vaccines cause the immune system to attack cells with one or more specific antigens. Because the immune system has special cells for memory, it's hoped that the vaccine might continue to work long after it's given.

- **Sipuleucel-T (Provenge):**This drug is used to treat advanced prostate cancer that is no longer being helped by hormone therapy. Side effects[4] are usually mild and can include fever, chills, fatigue, back and joint pain, nausea, and headache. A few men may have more severe symptoms, including problems breathing and high blood pressure.

- **Talimogene laherparepvec (T-VEC):** This vaccine is approved to treat advanced melanoma skin cancer. It is made from a herpes virus that has been altered in the lab to produce a substance that the body normally produces, called a *cytokine*. This cytokine boosts the immune system and can cause flu-like symptoms for a short time.

Other vaccines

Other types of cancer vaccines have shown some promise in clinical trials, but they are not yet approved in the U.S. to treat cancer.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/infectious-agents/hpv.html
2. www.cancer.org/healthy/hpv-vaccine.html
3. www.cancer.org/cancer/liver-cancer.html
4. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Last Medical Review: December 27, 2019 Last Revised: January 8, 2020

Cytokines and Their Side Effects

Cytokines are small proteins that are crucial in controlling the growth and activity of other immune system cells and blood cells. When released, they signal the immune system to do its job. Cytokines affect the growth of all blood cells and other cells that help the body's immune and inflammation responses. They also help to boost anti-cancer activity by sending signals that can help make abnormal cells die and normal cells live longer.

One specific type of cytokine is called a *chemokine*. A chemokine can make immune cells move toward a target. There are different kinds of chemokines, including *interleukins, interferons, tumor necrosis factors,* and *growth factors*.

Some cytokines can be made in a lab and are used to treat cancer. Some are used to help prevent or manage chemotherapy side effects. They are injected, either under the skin, into a muscle, or into a vein. The most common ones are interleukins and interferons.

Interleukins

Interleukins are a group of cytokines that act as chemical signals between white blood cells. Interleukin-2 (IL-2) helps immune system cells grow and divide more quickly. A man-made version of IL-2 is approved to treat advanced kidney cancer[1] and metastatic melanoma[2]. IL-2 can be used as a single drug treatment for these cancers, or it can be combined with chemotherapy or with other cytokines such as interferon-alfa.

Side effects[3] of IL-2 can include flu-like symptoms such as chills, fever, fatigue, and confusion. Some have nausea, vomiting, or diarrhea. Many people develop low blood pressure, which can be treated with other medicines. Rare but potentially serious side effects include an abnormal heartbeat, chest pain, and other heart problems. Because of these possible side effects, if IL-2 is given in high doses, it must be done in a hospital.

Other interleukins, such as IL-7, IL-12, and IL-21, continue to be studied for use against cancer too, both as adjuvants and as stand-alone agents.

Interferons

Interferons are chemicals that help the body resist virus infections and cancers. The types of interferon (IFN) are named after the first 3 letters of the Greek alphabet:

- IFN-alfa
- IFN-beta
- IFN-gamma

Only IFN-alfais used to treat cancer. It boosts the ability of certain immune cells to attack cancer cells. It may also slow the growth of cancer cells directly, as well as the blood vessels that tumors need to grow.

IFN-alfa can be used to treat these cancers:

- Hairy cell leukemia
- Chronic myelogenous leukemia (CML)
- Follicular non-Hodgkin lymphoma
- Cutaneous (skin) T-cell lymphoma
- Kidney cancer
- Melanoma
- Kaposi sarcoma

Side effects of interferons can include:

- Flu-like symptoms (chills, fever, headache, fatigue, loss of appetite, nausea, vomiting)
- Low white blood cell counts (which increase the risk of infection)
- Skin rashes
- Thinning hair

These side effects can be severe and can make treatment with interferon hard for many people to tolerate. Most side effects don't last long after the treatment stops, but fatigue can last longer. Other rare long-term effects include damage to nerves, including those in the brain and spinal cord.

Hyperlinks

1. www.cancer.org/cancer/kidney-cancer.html
2. www.cancer.org/cancer/melanoma-skin-cancer.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects.html

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

Immunomodulators and Their Side Effects

Immunomodulators are a group of drugs that mainly target the pathways that treat multiple myeloma and a few other cancers. They have many ways to work, including working on the immune system directly by turning down some proteins and turning up others.

Thalidomide, lenalidomide, and pomalidomide

Thalidomide (Thalomid), lenalidomide (Revlimid), and pomalidomide (Pomalyst) are known as *immunomodulating drugs* (or IMiDs).

These drugs can cause side effects such as drowsiness, fatigue, constipation, low blood cell counts, and neuropathy (painful nerve damage). There is also an increased risk of serious blood clots (that start in the leg and can travel to the lungs). These tend to be more likely with thalidomide than with the other drugs.

These drugs can also cause severe birth defects if taken during pregnancy.

Bacillus Calmette-Guérin

Bacillus Calmette-Guérin(BCG) is a germ that doesn’t cause serious disease in humans, but it does infect human tissues and helps activate the immune system. This makes BCG useful as a form of cancer immunotherapy. BCG was one of the earliest immunotherapies used against cancer and is still being used today.

BCG is used to treat early stage bladder cancer. It is a liquid put into the bladder through a catheter. BCG attracts the body's immune system cells to the bladder, where they can attack the bladder cancer cells. Treatment with BCG can cause symptoms that are like having the flu, such as fever, chills, and fatigue. It can also cause a burning feeling in the bladder. BCG can also be used to treat some melanoma skin cancers by injecting it directly into the tumors. It's also used as a vaccine against tuberculosis.

Imiquimod

Imiquimod is a drug that is applied to the skin as a cream. It stimulates a local immune response against skin cancer cells. It is used to treat some very early stage skin cancers (or pre-cancers), especially if they are in sensitive areas such as on the face.

The cream is applied anywhere from once a day to twice a week for several months. Some people have serious skin reactions to this drug.

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

Immunotherapy Safety

Much is known about the need to protect others from exposure to traditional or standard chemotherapy[1] because it is hazardous. This is why there are safety rules and recommendations for people who handle chemo drugs. However, because immunotherapy drugs are newer, there is not as much information about long-term effects of exposure. To be safe, many experts recommend treating immunotherapy drugs as hazardous and taking the same precautions. This is especially true when immunotherapy drugs are given to treat cancer in combination with other drugs that are known to be hazardous, so your cancer care team will take precautions to protect themselves and others from exposure to them.

Precautions the cancer care team might take

You may notice special clothing and protective equipment being worn by the nurses and other members of your cancer care team. Pharmacists and nurses who prepare drugs to treat cancer use a special type of pharmacy that must meet certain regulations. If you are being cared for in a treatment center, the nurses and others who give treatment and help take care of patients afterwards wear protective clothing, such as 2 pairs of special gloves and a gown, and sometimes goggles or a face shield. If you're getting immunotherapy through an IV, there might be a disposable pad under the infusion tubing to protect the surface of the bed or chair.

Special precautions when taking oral or topical immunotherapy

Oral immunotherapy that you take by mouth and swallow, or topical immunotherapy that you rub on your skin, is usually taken at home. Some are considered hazardous. There might be special precautions for storing and handling an immunotherapy drug. You might be told to be careful not to let others come into contact with it or your body fluids while taking it and for a time after taking it. Sometimes you need to wear gloves when

touching the pills or capsules. Some drugs have to be kept in the bottle or box they came in. And some drugs and the packages they come in need to be disposed of in a certain way. Some might have to be taken back to the drug store to be thrown away safely. If you are taking an oral drug, talk to your cancer care team about whether special precautions are needed at home.

Keeping family and friends safe

Unless your health care team tells you differently, you can usually be around family and friends during the weeks and months you're getting immunotherapy. If you're getting treatment at a center, family and friends can often come with you. However, some treatment centers only allow patients in the infusion area and visitors may need to stay in the waiting room.

You are the only person who should be exposed to the drug you are getting, but any spilled IV drug, and any powder or dust from a pill or capsule, or any liquid from oral or topical immunotherapy might be hazardous to others if they are around it.

It's important to talk to your cancer care team and be aware of any special precautions that might be needed while you are taking an immunotherapy drug.

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/treatment-types/chemotherapy.html

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Last Medical Review: December 27, 2019 Last Revised: December 27, 2019

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