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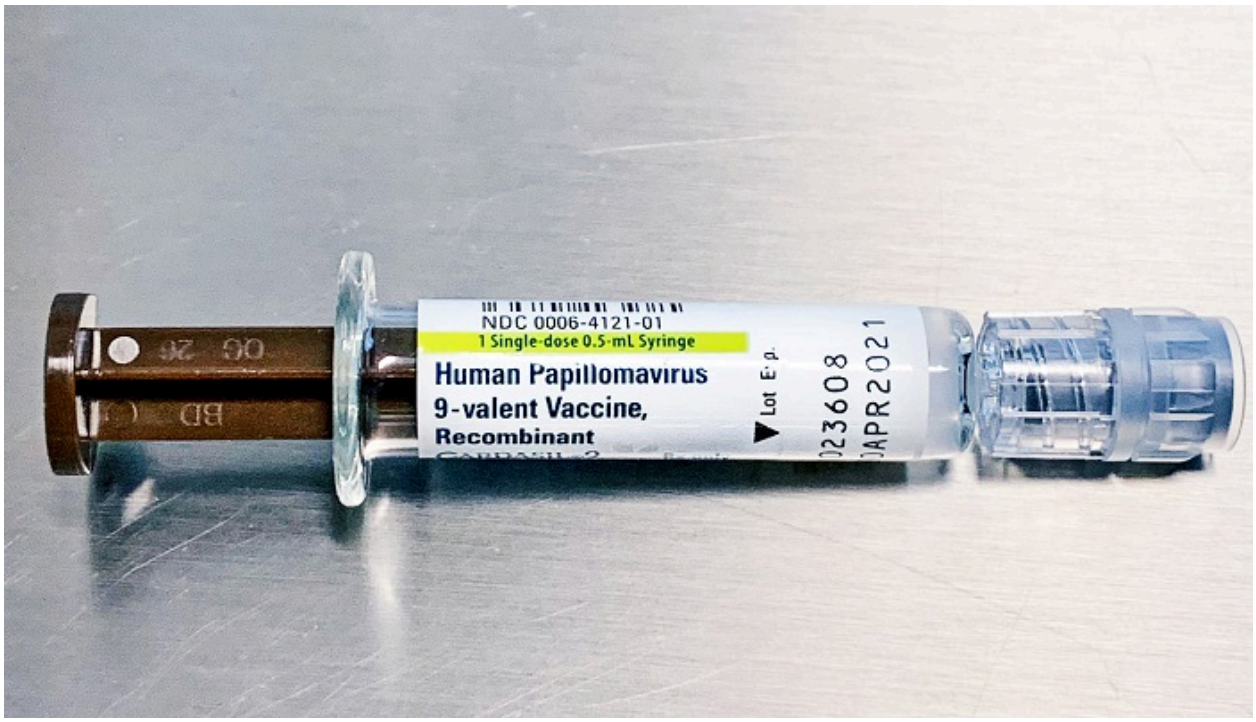
# A Revolutionary New Therapy for Cancer: The Cancer Vaccine




By Nikhil Wuppalapati

Cancer was the leading cause of death in 2020, and it is a disease that scientists have been working to find a cure for for decades. Survival against cancer is always uncertain. Even the diagnosis of cancer can be uncertain. And recovery is always an arduous struggle for patients, one that can be expensive, slow, and painful.

However, new developments in cancer therapy and treatment are occurring everyday. One such treatment may be vaccine therapy for cancer. Cancer vaccines are a relatively new invention, and only a few of them are approved. However, there are many more clinical trials happening, and the possibility of creating a vaccine for cancer is on the way.

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However, before discussing these new cancer vaccines, we should first discuss cancer and vaccines separately. Firstly, cancer is a disease caused by the uncontrolled division of your body's cells. This uncontrolled growth results in a tumor, which then needs to be removed before it spreads through the body. As the cancerous cells continue to divide, the genetic material that rests in the cell nucleus becomes more and more mutated and damaged.

Secondly, vaccines are created with weakened viruses or bacteria, which are then introduced into the body's immune system via a syringe. The body's immune system collects antigens from the weakened pathogen, effectively remembering it. As a result, the immune system will be prepared if the body is affected by that pathogen for real. Vaccines usually provide immunity, although they may have to be administered again over time.

However, cancer isn't like other diseases. Rather than being caused by a virus or a bacteria, cancer is the result of malformed genetic material in a cell's nucleus. This bad DNA gives bad instructions to the cell, telling it to divide rapidly when it shouldn't be. However, malformed DNA doesn't have any antigens for the immune system to remember. So how does a cancer vaccine work?

Well there are two types of cancer vaccines. The first one is a preventative cancer vaccine, of which there are only two. The human papillomavirus (HPV) and the hepatitis B virus can both cause cancer as a result of infection. Thus, vaccines for these two viruses also prevent the cancers that can be caused by them.

However, the other type of cancer vaccine, which is newly being developed, is a therapeutic cancer vaccine. Unlike other vaccines, which are given to prevent infection—and are therefore given before the infection occurs—therapeutic cancer vaccines are given while the

patient has cancer. They effectively act as immune system stimulants, helping the immune system identify the cancerous cells and destroy the cancer.

There are a few of these vaccines that already exist:

- The Bacillus-Calmette Guérin vaccine, which uses weakened bacteria to stimulate the immune system, and which is stimulated to treat early stage bladder cancer.
- The Sipuleucel T vaccine, which uses a patient's dendritic cells, which are immune cells (specifically, phagocytes) that also present antigens to immune B cells, and which is used to treat prostate cancer
- Nadofarene firadonevec, which uses a weakened virus to present cancer antigens to the immune system, and which is used to treat early stage bladder cancer that progresses past the Bacillus-Calmette Guérrin vaccine treatment.
- The T-VEC (Talimogene Laherparepvec) vaccine, which is composed of a modified herpes virus that stimulates the immune system, and which is used to treat melanoma skin cancer.

There are other clinical trials on the way to develop more vaccines that can be used to treat other types of cancer. As you could probably tell above, therapeutic cancer vaccines are manufactured in different ways. One way that cancer vaccines can be manufactured is from cancer-specific antigens. These antigens are made by the mutated cancer cells, and aren't found on normal cells. The vaccines introduce these antigens to the immune system, making it easier for the immune system to identify and attack the cancerous cells.

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Similarly, vaccines are made to target abnormal proteins that are created by mutated cancer cells, as well as proteins that are commonly overexpressed by cancer cells (meaning that they occur in larger amounts in cancer cells as opposed to normal cells).

Another form of cancer vaccine is a vaccine composed of an oncolytic virus. Oncolytic viruses are genetically modified viruses that only target cancer cells, ignoring normal cells. These viruses infect and destroy the cancer cells. Viruses can also be used by vaccines to present cancer antigens to the immune system.

Scientists can even go so far as to manufacture vaccines with entire cancer cells, in which the cells are altered so that it is easier for the immune system to identify them. These cells can either be grown in a lab or collected from a patient.

Finally, vaccines can be composed of dendritic cells, which are grown alongside cancer cells, and which also act as a stimulant for the immune system. The dendritic cells present antibodies to the immune system, and activate the body's killer T cells.

Cancer vaccines can be administered in different ways as well. The vaccine might be administered inside of a tumor, stimulating the immune system inside of the tumor in order to destroy it. (The immune system is stimulated by different substances, such as viruses, bacteria, antibodies, etc.) They may also be administered in tandem with another therapy, which usually occurs if the tumor is too big to be destroyed solely by the vaccine. These vaccines are usually administered subcutaneously or as intramuscular vaccines.

Although there have been many advancements in the production of therapeutic cancer vaccines, these vaccines are not without their challenges. Firstly, most of these cancer vaccines act as immune stimulants. However, cancer cells have immune system suppressants, which means that the immune system may not be able to destroy the cancer even when stimulated.

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Additionally, the cancer cells can be hard to identify, as they start out appearing normal, and later mutate. Also, if the tumor is too big or if the patient's immune system is already weakened, it may be harder to treat the cancer using the vaccines.

Cancer vaccines also have some mild side effects. Usually, they cause flu-like symptoms, including nausea, fatigue, or joint aches. Additionally, they may cause itching, pain, swelling, or redness. However, some side effects may be more severe. The T-VEC vaccine, which is made with a modified herpes virus, can cause a herpes infection, which is characterized by sores around the mouth, ears, genitals, and fingers, fatigue and drowsiness, eye pain and sensitivity, blurry vision, discharge from the eyes, and confusion. Additionally, the T-VEC vaccine can trigger tumor lysis syndrome, in which tumors die and break apart in the bloodstream, damaging organs like the kidneys, liver, or heart. The Sipuleucel T vaccine can result in stroke, and vaccines may also provoke an allergic reaction.

It is also hard to use cancer vaccines as treatment because it is hard to mass-produce them cost-effectively, and hard to keep track of immunity in patients. Additionally, it can be difficult to judge what combinations of substances should be used in vaccines, and when vaccines should be administered.

However, despite the challenges posed by developing cancer vaccines, there are still many clinical trials and promising results on the way. For example, there is a vaccine being developed for pancreatic cancer. There are other possible targets that are being tested to see if they can be used in a vaccine, such as different proteins or antigens.

Cancer has killed millions of people every year, and, even for survivors, it can be devastating. As a result, any new revelation in developing treatment for cancer is a good one, and

cancer vaccines seem promising. Hopefully, we will see these vaccines become the first step towards accessible and effective treatment for everyone.

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