

# **CANCER THERAPEUTICS – A SPECIAL FOCUS ON TDDS (TARGETED DRUG DELIVERY SYSTEMS)**

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Cancer, till date remains as one of the most feared and lethal disease on earth with about 18.5 million new cases and 9.5 million deaths around the world according to the 2018 statistics and by 2040 the numbers are expected to be about 29.5 million new cases and 16.4 million cancer related deaths.

The reason for this disease are many and sometimes becomes really hard to diagnose and even if it is diagnosed lately, the possibility of a person to be alive drastically decreases and this fact itself poses a deep effect on physical, emotional and social life of a person because it is really hard to know when he /she will be going to die!

Some of the widely known reasons for cancer are like smoking tobacco, diet and physical activity, sun and other sorts of radiation, viruses and other types of infections. Basically because of all such factors which are technically referred as mutagens, causes mutation which is the alteration in the genetic makeup of the cell which in turn leads to the abnormal functionality in the cell wherein it loses its property of contact inhibition because of which it grows boundlessly ie, forms undifferentiated mass of cells by consuming the nutrition all by itself and thus harming the healthy cells and becoming a tumor.

Some of the characteristics of cancer cells over normal cells are,

- 1) Self sufficiency in growth signals
- 2) Insensitivity to anti growth signals
- 3) Evading programmed cell death
- 4) Limitless replicative potential
- 5) Sustained angiogenesis
- 6) Tissue invasion and metastasis and the list continue.

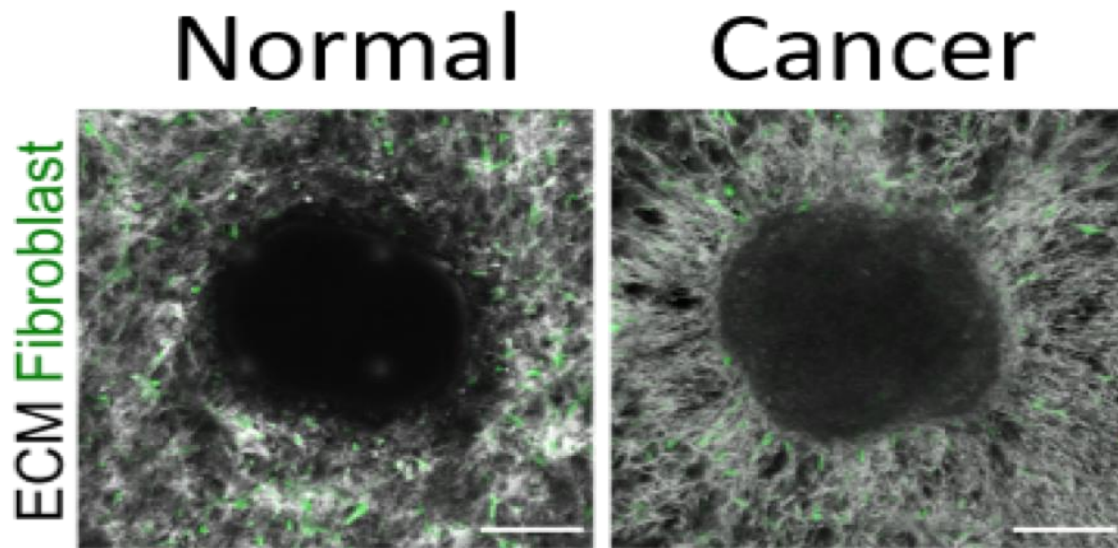


Image source:

<https://inbt.jhu.edu/stopping-cancer-in-its-tracks-hopkins-researchers-investigate-mechanics-of-cancer-progression/>

(Johns Hopkins institute for Nanobiotechnology )

Researchers, Oncology professionals, doctors and many other people are working towards designing and developing new efficient and effective drugs and over the course of time they have even been successful in achieving their motive and today we have many anticancer drugs as well as other therapies among which the mostly used one Chemotherapy.

Basically it is a type of cancer treatment that uses one or more anti-cancer drugs as a part of standardized chemotherapy regimen, however it is one of the most painful treatment which comes with lots and lots of disadvantages and side effects such as tiredness, feeling and being sick, hair loss, Infections, Anaemia, Bruising and bleeding , Sore mouth and many more .

Here we can see some more side effects of the Platinum based chemotherapy drugs like Cisplatin, Carboplatin and Oxiplatin in the below picture.

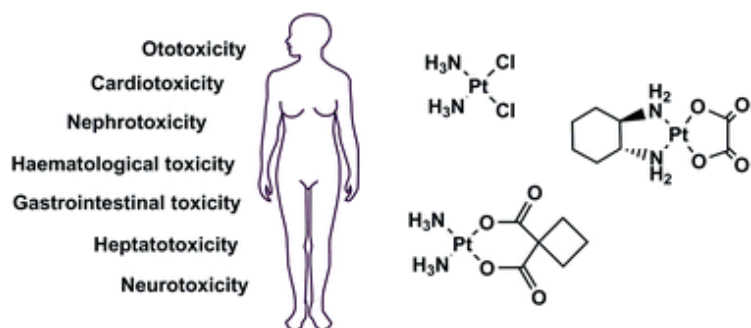


Image source : <https://pubs.rsc.org/en/journals/journal/dt>

Along with chemotherapy sometimes radiation therapy is also used wherein the cancerous part is exposed to high frequency radiations which burns the cancer cells but the major drawback is , along with cancer cells it also destroys the healthy cells around.

And even if we consider the oral, inter and intravenous consumption of anti cancer drugs still there is same chance of side effects seen.

Taking into the account of the advancements In therapeutics ie Nanobiotechnology, Polymer chemistry and Synthetic biology etc today it Is not just that we are developing drugs to inhibit and activate some surface cellular receptors to cure diseases but we are living the dream of Paul Ehrlich “ The magic bullets” Which he proposed a century ago wherein he expressed his thought about drugs selectively eliminating diseased cells by not harming any other healthy cells.

Which is today widely known as TDDS ie, Targeted drug delivery systems also referred as Targeted cancer cell therapy for cancer treatment wherein different or the desired drugs are loaded into chemically engineered nanomachines or nanobots which are chemically and biologically smart enough to identify the healthy and cancerous cells.

They not only identifies but also delivers the loaded drugs into the cancerous cells and eventually ends up in terminating them without harming the neighboring healthy cells.

In the below figure we can observe how the nanoparticle is loaded with the drugs and target molecule is set for the action ( Components of Nanoparticle mediated TDDS)

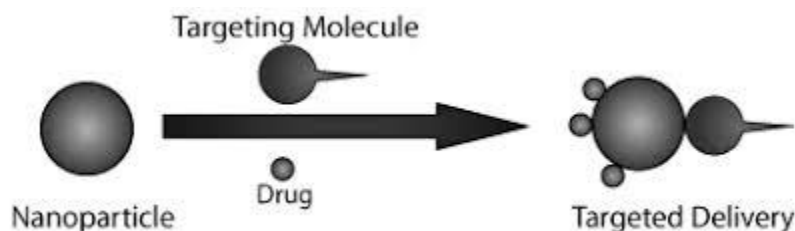


Image source :

<https://www.google.com/url?sa=i&url=https%3A%2F%2Fdoi.org%2F10.46624%2Fajptr.2018.v8.i4.001&psig=AOvVaw3Y41yNdAarluZKKX6vhacn&ust=1633295668677000&source=images&cd=vfe&ved=0CAkQjRxqFwoTCJD79NnSrPMCFQAAAAAdAAAAABAE>

The above self explanatory image is just the basic idea regarding how the TDDS works . There are N number of unique carrier devices designed by using different materials have been developed based on the compatibility of the drug within it and also with the cellular surface while interacting.

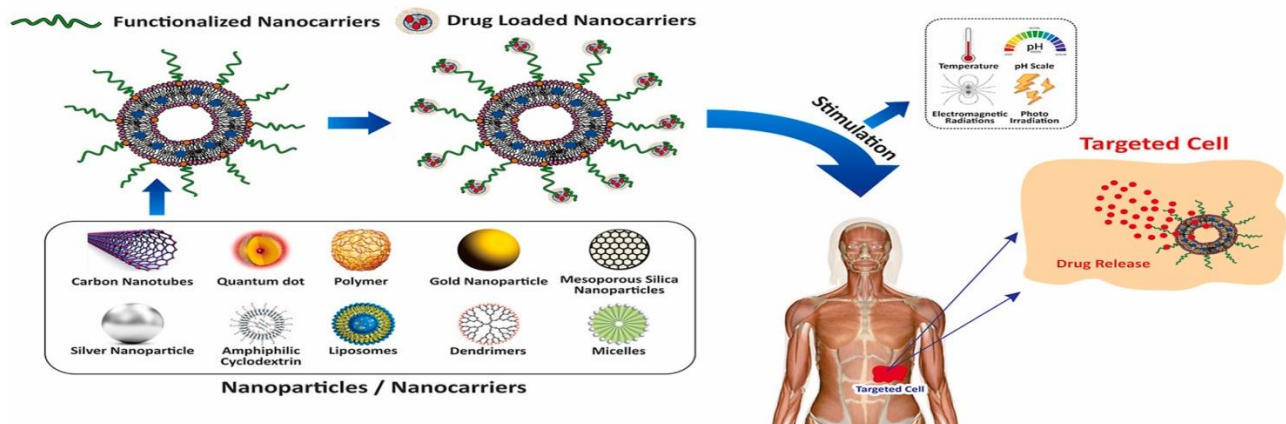
Sometimes the nanodevices are also not able to enter into the cell because of the compatibility and absorbing issues thus they are assisted by the ultrasound for the process to continue and such type of TDD is technically termed as 'Ultrasound enhanced transdermal delivery' which might not necessarily be used for cancer treatment .

Some carrier devices are light triggered and some other are triggered chemically. The carrier device is not necessarily be made up single material.

They may be made up of lipids in the form of spheres , tubes, micelles, dendrimers etc made up of gold, carbon , silver even sometimes DNA is also used as a fragment to build nano devices.

We can see different types of carrier devices in the figure below.

# Targeted Drug Delivery System



Imagesource:

<https://www.sciencedirect.com/science/article/abs/pii/S1773224721001064>

Complete mechanism of Targeted drug delivery systems for cancer treatment in a nutshell , A self explanatory image.

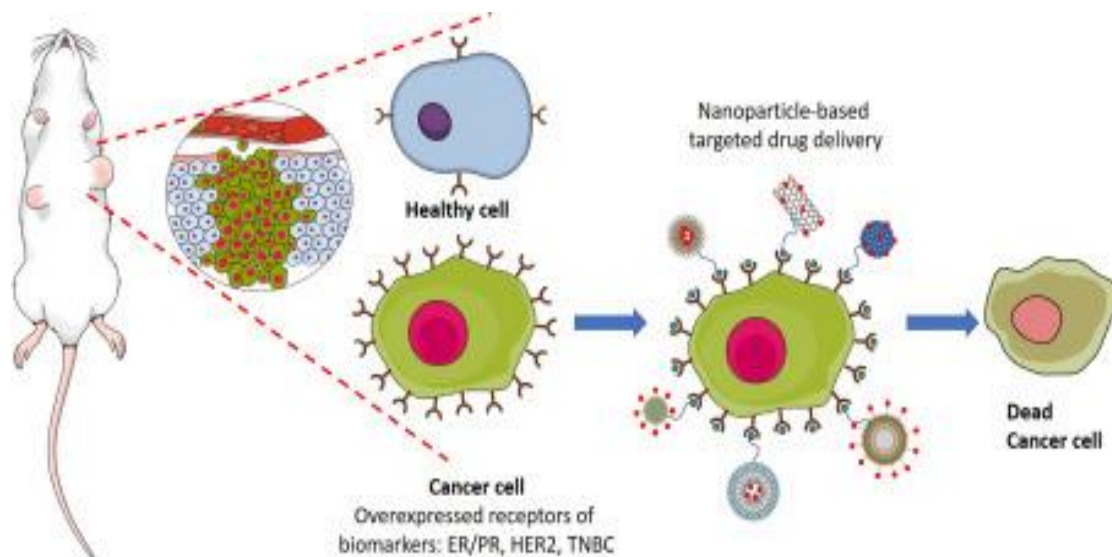


Image source :

<https://www.sciencedirect.com/science/article/abs/pii/S0304419X19300332>

In this way TDDS is a more effective way to deliver the drugs using different means to reach the targeted part of the body and to deliver the drugs efficiently with very minimal side effects and without causing damage to the other healthy cells.

For additional visualization, please use hyperlinks mentioned below.

<https://youtu.be/aFU5Qx-cLu8>

<https://youtu.be/emEua2eJp1U>

<https://youtu.be/6UXxmTFsNf0>