

**KEYWORDS**

**Cancer**  
**lifestyle Disease**  
**Stem Cells**  
**Genomics**  
**Drug Discovery**

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**Cancer therapy: Challenges and new hopes**

While walking on the river side, my grandfather who was a farmer told me during my childhood that it is very difficult to kill a tree. The logical reason is that the tree is deeply rooted and cutting the trunk at the ground level doesn't help. Being a researcher, I realized that it is easy to kill a tree than a cancerous cell that freely floats in our body. But now, I am learning that even cancer can be uprooted by knowing the root reasons with advanced technologies. I therefore would like to share with you all, the new hopes for cancer therapy that somehow did not achieve enough adoption. The issue will be on the use of stem cells and genomics for personalized cancer therapy.

One of the major lifestyle's diseases, cancer is a dreadful disease for an organism but for a living cell, it is a survival stunt. To divide is to survive for a cell. A living cell is more intelligent and determined than a living organism. An organism with the matured brain can make mistakes but a cell without brain rarely makes mistakes in its determination to survive, and stem cell is the God for both living cell and the organism. This is because a single stem cell can give rise to any cell of an organism. Stem cell basically represents a time machine that allows modern researchers to generate all types of cells present during an individual's birth. Following the same quality, a pro-cancer cell by acquiring some of the stem cell properties becomes a cancer stem cell and therefore leads to cancer by uninterrupted cell divisions. Cancer stem cell and stem cell sound alike but possess differences. While some cancers carry genetic basis, majority of the cancers are lifestyle driven.

Cancer is a leading cause of death in both developed and developing countries, and is an increasing medical burden worldwide, due to population growth and aging. As per Indian Council of Medical Research (ICMR) cancer registry data, the estimated incidences of cancer patients in India are 13,28,229, 13,88,397, 14,51,417 and 15,17,426 during the years 2014, 2015, 2016 and 2017, respectively. While estimated deaths due to cancer during these years are 670541, 701007, 732921 and 766348, respectively.

Personalizing therapy means giving patient specific treatment by taking clues from either genetic data or/ and providing autologous/ allogeneic stem cells as therapeutic tools in disease management

**Problems with current cancer therapy**

- There is no cancer drug that does not cause side effects in the patients.
- Some drugs work on some but not on others. In other words, some patients respond to therapy and some do not.
- Outside the hospitals, patient population think that cancer therapy actually speeds up their death than they would be without therapy.

## What is the solution?

Personalized cancer therapy: This means that each patient can receive a customized drug combination for which they respond and recover.

## What knowledge is required to take a call on personalized therapy?

Earlier, a limited number of cancer specific cellular markers were profiled to know the patient's response for a particular therapy. This method did not work because of the low number of drugs available in the market and also diagnostic/prognostic markers are limited. So, experts have started looking at a larger picture of individual patient's biochemistry through advanced technologies like genome sequencing called as human genomics.

## Why genomics?

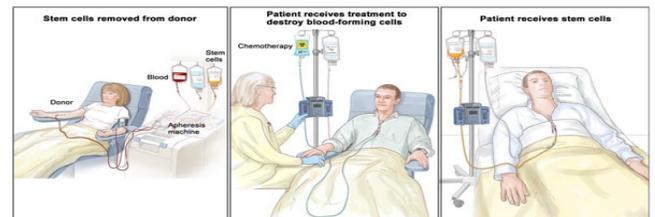
Genomics is a study of understanding the whole complement of genes in the human genome. This is done by sequencing the DNA/RNA of the patient before and after treatment. This is because, our genome decides our biochemistry. Understanding the genome wide changes under cancerous condition will give a clear picture of patient's biochemistry and therefore enables planning for personalized therapy.

## How are stem cells useful in cancer treatment?

Cancer is mainly treated using surgical resection, fractionated radiotherapy, and chemotherapy. The side effects associated with these treatments result in tissue damage, loss of blood immune cells, loss of stem cells therefore completely compromising the human system. To overcome these, stem cells have been in application in regenerative medicine, immunotherapy, cancer stem cell-targeted therapy, and anticancer drug screening applications. The use of these applications is very low in developing countries like India because of the expensive technology.

## Regenerative medicine:

Given their self-renewal and differentiation capabilities, stem cells can be used to repair human tissues after chemotherapy. Transplanting Hematopoietic Stem Cells (HSCs) has been widely clinically used to facilitate lifelong hematological recovery after treatment of cancer with high-dose radiotherapy or chemotherapy.



Stem cell transplants help restore blood-forming stem cells in people who have had theirs destroyed by certain cancer treatments.

## Immunotherapy:

Introducing genes encoding chimeric antigen receptors (CARs) or T-cell receptors (TCRs) directed against tumor-associated antigens makes HSCs attractive for use in cancer immunotherapy. According to experts, this method is the only future for curing cancer in the most efficient manner without side effects.

## Where do we get stem cells?

For adults, stem cells are generally isolated from bone marrow which is quite a painful process. Stem cells can be best isolated and cryopreserved during a child's birth (Cord blood and tissue) and in infants (dental pulp of milk tooth). Stem cells can be isolated from our body or from other donors within the family or outside. But graft rejection is a problem with donor stem cell transplantations and therefore biomedical centres often prefer autologous (which means the stem cells come from you, the patient) transplantation.

Stem cells isolated from cord tissue and tooth donor cause rejection and are majorly infused to address graft rejection, like cyclosporine drug. These stem cells are better than cyclosporine as they cause no adverse side effects.

### What is the current status of Stem cell technology?

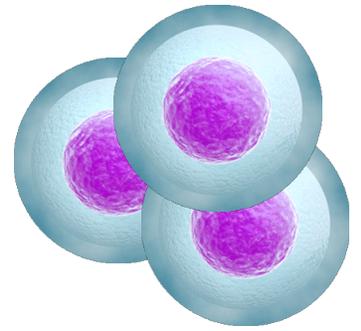
Stem cell technology is on the way to boom with successful clinical trials in developed countries. The success wave has almost touched the developing nations like India and awaiting outreach. Moreover, latest technologies have arrived that can enable clinicians to specifically filter out desired immune stem cells and use for transplantation in order to minimize graft rejection problems. However, the full fruits of this technology will be available to future generations provided current parents store their children's stem cells now.

### That's fine. But what is the status of Drug discovery?

Yes, drug discovery had few successful stories on board and it has been a never ending process with benefits unique from natural therapies. On an average, it takes atleast 10-15 years for a drug to get approved into the market that may have side effects. On the contrary, a cancer cell divides for every 24 hours. Just imagine the difference in the time lines. Therefore, it is always good to have a sword with two sharp ends, one is drug discovery and the other is the stem cell therapy. Good news is that stem cell therapy is devoid of side effects and moreover stem cell

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