Challenges and Advances In Cancer Research

According to the American Cancer Society Chief Medical Officer Otis Brawley, MD, one of the greatest challenges to cancer research is lack of money and resources. Another barrier in advancing research is the lack of patients taking part in cancer clinical treatment trials [7].

Extensive cancer testing of healthy people has led to the discovery that most people are going to get cancer in their lifetime, but that in many cases the disease would disappear on its own. That implies that many people are treated with surgery, chemotherapy and radiation therapies even though their cancer would disappear on its own. The problem is that doctors and researchers can't tell which case will need treatment and which case is benign. This is an important step that needs to be sorted out as it would stop over-treatment of patients.

The 18th century definition of cancer looks at the aspect of cancer cells under the microscope. This is the histological view of the cell. The next step would be to consider the genomic makeup of the cancer cells [7] which may be able to better show which cancer is virulent and which is not.

Many of the same challenges faced by cancer research are faced by science in general. Science transforms our lives and our understanding of the world for the better. But now it needs to transform itself [3]. The idea "trust, but verify" which is the way science treats research results is being challenged in practice. Often research can not be replicated. One bio-tech company called Amgen found that they could replicate only 6 of 53 "landmark studies" in cancer research [3]. One of the reasons this is happening is the fact that there is a large number of researchers that compete for a small number of academic positions. Verifying results is not considered as advancing a scientific career hence few are doing it. There is also a tremendous pressure to "publish or perish". Many are tempted to exaggerate their results or ignore inconvenient data. Very often it is good to know about the failure to prove a hypothesis but such studies are usually not accepted for publication. Only 14% of published articles have negative results. Not reporting failures means that scientists will waste money, time and resources on projects which are not successful, because as other groups have already explored and failed to prove the same hypothesis [3].

An important article about immunotherapy in the Scientific American, the March 2017 issue, details the hardships that the team that designed the CAR T Cell therapy encountered from the review panels at federal research agencies. Their very important research was considered too risky and their funding was stopped. In August 2011, Avery Posey, Carl June and Bruce Levine published their findings in two medical journals, the New England Journal of Medicine and Science Translational Medicine. The extraordinary interest from the media, the biotehnology start-ups and companies who wanted to license the new technology of fighting leukemia and lymphoma changed the way their research was viewed and they ultimately succeeded in securing a federal grant. It was a close call, because if they wouldn't have published at the right time, their research wouldn't have been recognized and used.

This highlights some of the problems researchers face. They are dependent on funding for their research. However if their research is not well understood or too innovative then it is deemed to risky for patients. This encourages selecting "safe" projects for scientists, projects that are not too bold, and are considered safe at that moment.

Another problem researchers face is the extensive paperwork they have to fill out if they want funding. Not only is money a problem, but time is. Researchers would rather work on their project than face a mountain of paperwork.

Researchers have to be business-savvy as they often have to know how to communicate with different agencies and businesses for funding. Bigger labs have to deal with multimillion dollar projects and know how to advertise their findings and collaborate with companies and agencies. A smaller lab or research group will find it harder to be competitive in this environment.

Research in biological science has also become interdisciplinary. For example, genetic research involves “big data”, statistical knowledge, and computer science expertise.

The story of William Coley's research is interesting because it shows that politics influences how research is done. William Coley was a surgeon who came across a patient whose cancer regressed after the patient got a severe bacteria-caused skin infection during his stay in the hospital. He started a cancer treatment by injecting patients with a mixture of heat-killed bacteria hoping to stimulate the body's cancer fighting powers. By that time nothing much was known about the immune system. Coley's treatment however couldn't be replicated and was ultimately abandoned.

Coley's treatment was used by many others, including the Mayo brothers and an orthopedic surgeon called Henry Meyerding. Dr Meyerding used the bacterial toxins with surgery and his patients had better survival rates than by surgery alone.

Coley's son, Bradley also used successfully his dad's treatment in the 1950s. But why was Coley's treatment abandoned after many successful results? The answers are complex. Different laboratories had different formulations and levels of potency. That means that different doctors got different results that were not easily replicated. Coley also tailored the treatment specifically for each patient, trying to keep the patient's temperature high at all times. Other doctors weren't so dedicated to this schedule and followed the traditional visiting schedule and they did not maintain the high fever that was a sign that the immune system was revving up. As a consequence, results weren't always positive. Also, radiation therapy started around the same time and the results were positive and uniform. The director of the hospital where Coley worked, Dr. Ewing, believed that radiation should be used for every cancer patient. Another doctor, Cornelius Rhoads, at the same Memorial Hospital where Coley and Ewing worked was very passionate about using chemotherapy. In 1955, he ordered the production of Coley's toxins stopped. If it weren't for his daughter, Coley's toxins would have been forgotten. She kept all of Coley's letters and results. She founded the Cancer Research Institute in 1953. Today, Dr Coley is credited for starting cancer immunotherapy. His almost forgotten research finally got the recognition it deserved.

One of the ways to fix some of the problems with cancer research is to make learning statistics a priority so research results are presented accurately and without any mistakes. The introduction of AP Statistics in high school is a measure that will help young scientists design better clinical studies. Protocols for conducting experiments should be registered before the study is done, so it becomes impossible to change the protocol later in an attempt to present results in a positive light. Trial data should be made publicly available so it can be inspected and checked by fellow researchers [3]. Medical journals should accept more articles with negative results and publish them because it is good to know also what direction not to go in with research. There should be more peer review of articles so that mistakes are caught before publication. Author and reviewer comments should be appended to articles after the publication of the article. Often, researchers rely on “landmark” studies and if these studies are not accurate, then the work of many others is also negatively impacted.

Research shouldn't be always safe. Many scientists have hunches and interests that are leaps away from current research and their work could be innovative and interesting. Finally, agencies that offer grants should make it easier for scientists to fill out paperwork so they spend more time in the lab.

The causes and prevention of cancer are not well understood and only a small fraction of research money is spent on prevention. More money on prevention and finding the causes of many cancers is necessary. Some topics like metastasis of cancer receive only 5% of the funds. Metastasis is actually what is killing cancer patients and is the process by which cancer cells migrate to other parts of the body. It should be better understood and the topic should receive more funds.

While there are about 800 new anti-cancer drugs, the participation rate among adult cancer patients is extremely low, about 3%. About 40% of trials fail to achieve minimum patient enrollment,

which leads to a huge waste of effort and resources. More than three out of five phase III trials fail to achieve minimum patient enrollment [9]. Patients fear a reduced quality of life, don't want to receive a placebo, fear potential side effects and are concerned that the drug they receive might not be their best option[9]. Educating patients about the importance of clinical trials may help in alleviating this problem. Patients are now routinely tested for the molecular structure of their cancers using tissue samples increasing the logistics of organizing cancer trials. For some rare patients subsets there may not be enough patients in the US and trials are becoming increasingly global [9].

The annual budget of NCI (The National Cancer Institute) is currently at $5.21 billion [8]. To these billions of dollar, one has to add the billions spent by drug companies on cancer research. In 2011, drug companies spent about 49 billions on cancer research. There are 260 non-profit organizations that raise money for cancer research and their budget is about 2 billion dollars. There is a lot of money pouring into cancer research. Years ago, cancer was a death sentence where today it isn't anymore. Still, there is a lot that needs to be done. A lot of drugs are extending life by a few months only and that is not enough. Many cancer patients, breast cancer patients, have a longer life expectancy and will be cancer free thanks to the efforts of hundreds of thousand of cancer researchers who dedicate their lives to curing cancer.

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