



INNOVATION IN MEDICINE – NEW IDEAS FOR TRANSLATION

Medical Science

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ABSTRACT

The modern day health care system is a well-integrated and efficient collaboration between medicine, technology, spirituality and genomics. The last century has given rise to a plethora of innovations in the healthcare industry, with a singular aim of enhancing life expectancy, diagnosing and treating diseases and providing cost effective medical care. But times are changing and this change is taking us forward to a better future.

KEYWORDS

Innovations, Personalized Medicine, Breast Cancer, Genetics, Amr

INTRODUCTION

Imagine walking into a doctor's office for a routine check-up and the doctor scans your body to the cellular level to detect any risks of an ongoing or dormant diseases, or imagine a case where cells can be harvested from an individual, to form spare body parts and organs. These might sound like futuristic fantasies from a science fiction book but in reality these are some of the many technologies that are being developed today. These two technologies have two key characteristics which are shared by almost every innovation that pushes our radical methods forward. The first is the ability to provide a personalized targeted health care system, second, the concept of regeneration and biosynthesis.

PAST, PRESENT AND FUTURE

In the past decade a lot of research has been oriented with particular sects of population in mind, women and children have become the centre of attention while diseases like cancer is the most researched disease of our century. It is not only innovation in medicine but the development in technology that provides us valuable data on the prevalence of disease and the effectiveness of the current medicine. The 2030 Agenda of WHO^[1] is Sustainable Development which is the world's first comprehensive blue print for sustainable development. WHO, attempts to frame innovation not only as the development of new technologies and inventions but also a path to find novel ways of their implementation, for the expansion of the common platform for health delivery, medical, social and environment related problems.

Hippocrates of Kos, "The Father of Medicine" is one of the most influential people in the field of medicine. The achievements of the writer of the famous "Corpus" are still an inspiration to practitioners, innovators and visionaries alike. During his life he strongly argued and called for physicians and medical practitioners to engage in research with an aim to push medicine forward. One of his many contemporary ideas is the leading interest in innovation that is the concept of personalized medicine. He understood the importance of treating every individual based on the signs and symptoms which he understood did not differ in different conditions but were unique for every person in some way. The new age medicine believes in the concept of precision or personalized treatment over the "one size fits all" treatment. Today we are in the process of finding the uniqueness in every individual's condition in order to provide a more targeted and safe treatment modality.

One of the most influential discoveries are being made at the cellular and molecular level. The field of genetics is booming with innovations that are attempting to eliminate several genetic disorders by the following decade. A revolutionary mode of tackling these is CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats). It was discovered as a genetic archive system in bacteria by Francisco Mojica, which serves as "memory" against viral attacks. CRISPR contains a protein CAS 9^[2] that has the ability to modify any given DNA sample at the precise site of our choice. This tool can be used to engineer biomedical compounds and drugs, synthesis distinct parts of DNA, edit mutations out of our genes and even produce a defect free

DNA or someday synthetically engineered babies. About more than 3000, known genetic disorders are the result of a single code mutation, and CRISPR is a one man army against our war against genetic conditions ranging from colour blindness to cancer. The marvel of this discovery lies in the fact that not only has it brought down the cost of genetic engineering in living cells exponentially. It has also significantly reduced the time taken by a lab to get results. Such discoveries serve as a beacon of hope for second and third world countries where medical health facilities are still a luxury. One of the many ground breaking discoveries made using CRISPR include the design of Chimeric Antigen T cell (CAR-T) against terminal lymphoma cases. Other breakthroughs in the domain of genetics include gene based strategies as a part of precision medicine.

PERSONLIZED MEDICINE

According to WHO, Breast cancer is the most frequently occurring cancer around the globe amongst women, impacting about 1.5 million females per year. Today prevention is the basis of innovations concerning breast cancer. Mammaprint^[3] is a genomic test that analyses the genomic code of breast cancer cells to determine the risk of cancer reoccurrence in women receiving chemotherapy. Gene Assay is an FDA approved test which provides a personalized, definite result regarding relapse risk assessment. Consumer BRCA testing is a use-at-home genetic testing kit for detection of three BRCA gene mutations linked with breast, ovarian and other cancers. As for the treatment modalities, targeted and personalized therapies are our arsenal in the battle against breast cancer. For breast cancer patients with BRCA 1 and BRCA 2 positive there is new hope in targeted gene therapy which is already seeing new success. HER 2 Positive cancers impacts 20% patients and is often resistant to traditional method.^[4] Gene therapy though an archaic concept, our approach here is novel and so are our results. These methods may well eliminate the use of chemotherapy in many cases. The global epidemic "Diabetes" is being intercepted by researcher, on-going studies show that the development of induced pluripotent stem cells as a viable therapy for Type 1 diabetes. The generation of these cells has proven to help in pancreatic insulin secretion. Also gene repair of mutation with cysteine-aspartate protease (caspases) completely fixed the disease caused by mutation of Stat 3 gene.^[5] Researchers at the Arizona State University succeeded in creating a single long strand of DNA or RNA that can self-fold to form large complex structures. This technique, known as DNA origami can be carried out inside living cells and used for drug delivery at the nanoscale. Human imagination is the mother of everything we see around us and we gather inspiration from nature. At present the brilliant minds of our generation are fascinated by Axolotls. These tiny but fascinating creatures are gifted with the ability of regeneration like no other animal on earth. It can regenerate any and every part of its body any number of times. This nature's marvel is what can be the answer to several of our problems. There are numerous diseases and threats that inflict the human body and but Antimicrobial resistance (AMR) is a global health crisis now. At the current rate of emergence and spread of AMR, annual loss of life is expected to reach 10 million deaths by 2050 with an estimated economic cost of \$100 trillion worldwide.^[6] A team of researchers recently discussed a device

utilizing DNA hybridization to identify resistance genes in bacteria that reflect antimicrobial susceptibility. Presently, they have employed this technology to identify the presence of methicillin resistance in *Staphylococcus aureus*, one of the high-priority antimicrobial resistant bacteria known to cause trouble in health-care settings globally. These are just the tip of the iceberg, a grain of sand in the vast desert of genetic innovations that will change human lives forever.

THE FUTURE OF DIAGNOSTICS

Modern age medicine would be a dream without the birth of modern day technology. Medical devices have enhanced our diagnostic, treatment and rehabilitation methods by many folds and it's needless to say that without the advent of biotechnology medical science would still be in the dark. The vast numbers of devices that are shaping the medical industry include devices such as Spy Portable Handheld Imager (SPYPHI). It is a FDA cleared Fluorescence imaging device that allows surgeons to Blood flow and related tissue perfusion in real time, thus helping reduce surgical complications and correct detection of the tumor. ABVS (Automated Breast Volume Scanner) at Jaslok Hospital and Research Centre Mumbai is another such device that scans the tissue for an early diagnosis. 3-D printing is an emerging futuristic concept which has taken our field by a storm. From functional organs to mechanical devices for screening and diagnosis printable technology is a crucial part of modern day medicine Biozorb, A 3-D implantable Device is used as an alternative to titanium chips in area needing follow up radiation after surgery. It allows A clear target and Precision Radiation which reduces risk of over dose and complications. Breast GPS by the name of SANSCOUT uses electromagnetic waves to locate the smallest tumor and provide a conservative approach and reduce need of Lumpectomies. Against AMR a team based in India innovated, a credit-card-sized device that was able to rapidly identify any of the four commonest UTI causative organisms from a small sample of urine. The aim was to identify polymicrobial infections, so that antibiotic therapy can be tailored towards all responsible causative microorganisms. Similarly, a team from Israel devised a method for identifying antimicrobial susceptibility. This was achieved through direct monitoring of bacterial growth through light reflection, using a silicon micro-pillar array, in the presence of the various antibiotics commonly used.

CONCLUSION

So, far the clinical trials for each of these innovations are a triumph, but they don't come cheap. The need for affordable innovations especially in countries like India, should govern our conscience and ideas.

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