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3D Printing – Emerging As A Significant Technology in Healthcare

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3D printing has been in use since the 1980s as additive manufacturing. However, this technology quickly gained popularity in the 2000s, when people finally began to realise its importance and what it can actually do for the betterment of the human species.

From 3D-printed shoes to vehicles, additive manufacturing has mastered almost every aspect of human lives. According to a report published by Forbes, the 3D-printing industry grew by 35.2 percent in the year 2014 to cross the $4 billion mark. The company based its claim on the Wohlers Report 2015. According to Forbes contributor Panos Mourdoukoutas, this clearly indicates that the additive manufacturing industry is growing by leaps and bounds.

Medical 3D-printing continues to remain one of the biggest breakthroughs in the field. In fact, it is fair enough to say that medical 3D-printing is slowly becoming a part of the mainstream medical practice. 3D-printing is shaking up things in a big way in the medical world and experts claim that this is just the tip of an iceberg.

Several 3D-printed solutions have been created to benefit patients across different specialties. For example, 3D-bioprinted airway splints for babies who are at an increased risk of the collapse of tiny airways around the lungs was the first 3D-printed implant made for kids.

What makes this implant special is its ability to grow with the baby. Additionally, a single implant can be created in less than an hour, has been clinically tested in toddlers, and costs just $10. Why wouldn't anyone love a technology that can provide these many benefits while saving a precious little life?

This article specifically looks at the applications of 3D-printing in the medical world and how it is emerging as one of the most promising technologies in healthcare. Additionally, it explores some of the challenges associated with 3D-printing that must be managed before it becomes possible to reap its benefits fully.

3D Bioprinting in the Medical World

Many 3D-bioprinted solutions are still in the experimental stage and much of its work is in progress. However, there are many solutions that have already been launched and are currently being used and applied in so many ways in different parts of the world.

People widely believe that the ultimate aim of 3D-printing in the medical world is to provide a replacement organ for patients. However, that is just one of its applications. 3D-bioprinting has touched and started to revolutionise almost every aspect of medical care – from pharmaceuticals to the manufacturing of implants and organ development. The following are some of the most important breakthroughs in 3D-bioprinting.

Bioprinted organs

It is now possible to create functioning organs with the help of 3D printing. 3D-printing makes use of digital models to create a replica by adding layers of printing ink on top of each other until the final product is made.

Because skin is already made up of several layers, it is considered as a perfect and the simplest candidate for 3D-bioprinting experimentation and implementation. A team of scientists based out of Madrid have already used a bioprinted skin for transplant in mice. The researchers submitted a prototype for a 3D printer that could create fully functional human skin that can be used for transplant in the case of burn victims and for research purposes.

Similarly, scientists have also created 3D-printed ovaries and successfully implanted into the mice. Such innovative solutions can help manage one of the most traumatic conditions in the life of a woman – infertility.

Organs such as kidneys, liver, and heart are still restricted to the research labs. However, it is estimated that they will be made available within the next five years. CollPlant Holdings Ltd., an Israeli bioprinting company, is leading the 3D-bioprinting revolution in organ development by using the rhCollagen technology. This technology uses plant-based products to produce tissues.

Addition, researchers at the company have figured out a way to produce collagen, which is a protein that gives elasticity to the skin. The team believes that liquid collagen can be used as an ink for the 3D-bioprinter and this could lead to the development of the much anticipated bioprinted organs.

The availability of 3D-printed organs can eliminate one of the long-standing problems in the field of organ transplantation – waiting time. On an average, a patient has to wait for more than two years to receive an organ such as kidney and heart. Many patients around the world lose their lives waiting for a suitable donor. 3D-bioprinting can help manage such issues.

Bioprinted anatomical models

It is now possible to print 3D-printed plastic anatomical models of the patient's body parts that the surgeons are planning to operate on. This may include a 3D-printed ear, denture, or a skull.

This can be done before the surgery so that the surgeons can plan the procedure in a better way. It is estimated that doing so can cut the time of a surgery by as much as 33 percent. Shorter duration of surgery can reduce the risk of infection and increase the rate of recovery of the patients, thus ensuring shorter hospital stay.

Bioprinted bones

In August 2017, a team of doctors at the Shanghai Changzheng Hospital successfully used 3D-printed bones to carry out a complex vertebra replacement on a 28-year-old patient. The patient was diagnosed with cancer in the neck. Due to unavailability of an implant for bone replacement, the doctors decided to use the 3D-printed replica using titanium alloy as the ink.

This clearly indicates that the technology can be used successfully for the treatment of the most complex forms of cancer. Most importantly, the surgeons are willing to use innovative solutions to save the lives of their patients.

Bioprinted pills

It will soon be possible for people to print the drugs at home using an affordable 3D-printer. All they will have to do is show their prescription to an online drug store, purchase the digital ink and the blueprint, and feed it to their printer.

This concept seemed too unrealistic when it was first introduced by the chemist Lee Cronin at a TED talk. However, it soon became a reality with the US Food and Drug Administration (FDA) approving the first 3D-printed pill for epileptics patients in 2015.

It is believed that customised medicine will revolutionise the way how people will get themselves treated in the near future. Even though there are several challenges associated with this application that is yet to be resolved, the idea of 3D-bioprinted pills still seems promising.

Bioprinted implants

It is estimated that more than 10 million people in the UK alone suffer from hearing loss. The situation is somewhat similar around the world. In such a scenario, there is a great burden on the healthcare system to treat and provide cochlear implants and hearing aids to people with profound hearing loss.

Medical bioprinting is a boon when it comes to the management of hearing loss. Now scientists around the

world are using this novel technology to create patient-specific implants and prosthesis to treat hearing loss in them.

Apart from hearing loss, 3D prosthesis and implants are now being used for facial and breast reconstruction, ankle replacement, tissue generation, acetabular reconstruction after an accident, hip replacement, maxillofacial defects, respiratory disorders, and bone infection and bone cancer as well. These are some of the areas where 3D-bioprinted implants can be successfully used to achieve the desired results.

3D-Bioprinting Challenges

Challenges are an important part of every medical technology. However, it makes the scientific workforce around the world to work even harder and bring in newer solutions to eliminate challenges and so is the case with 3D-bioprinting.

Even though medical bioprinting is a cheaper technology as compared to the alternatives available but the availability of technical expertise to install the system and make the optimum use of it continues to remain a challenge for the healthcare industry.

Additionally, clinical trials and regulatory clearance before the solution is made available to the consumers still take a long time. For the regulatory bodies, quality assurance and quality control remain the two biggest challenges when it comes to 3D-bioprinting and it can definitely impact the scalability and the long-term adoption of this technology.

Nonetheless, medical 3D-printing offers a great opportunity to the healthcare industry. This novel technology is a highly affordable, accessible, and attainable, and this is the reason why researchers and the medical fraternity around the world have been showing their willingness to explore this technology. The transformation that 3D-bioprinting is yet to bring in the healthcare industry is certainly going to be worthwhile.

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